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ELECTRIC VEHICLES AND THEIR RELATIONS TO CENTRAL STATIONS.

A THOUGHTFUL paper on this subject—giving, to use an expression of Prof. Perry, "an answer to the question which is in all our minds"—was recently read by Mr. Percy Maxim before the American North-Western Electrical Association. Mr. Maxim claims for electricity, and also for the American manufacturer, the most important position in relation to automotric traction on common roads; and his contention is in both cases strongly supported. On the Continent of Europe, and especially in France, motor carriages have multiplied to such an extent as to require the careful consideration of the legislative and municipal authorities, and they constitute an important factor in the life of the people. The French, however, in spite of their great success in developing the oil-motor type of vehicle, have, until recently at least, overlooked the practical aspect of the question, and the paramount claims of electricity from this point of view, in their eagerness to outdo one another in long-distance runs and trials of speed, which has become the controlling factor of their progress. "They have," says Mr. Maxim, "only just begun to turn their attention to the pecuniary advantages of the automobile." The credit of an early comprehension of the importance of the electric vehicle and of the fact that it offers the quickest and easiest solution to the problem of economically applying automobile traction to practical use, is due to the American manufacturer. It is not denied, however, that an extensive and useful field awaits the gasolene motor in its development.

The ready sale of American electric carriages, which is effected abroad in the centres of antomobilism, testifies to the correctness of the views held by their manufacturers as well as to the excellence of American methods in design and manufacture.

But a broader application of the electric motor carriage to the commercial requirements of modern civilisation resides in the immediate future. This cannot be doubted by those who are familiar with the careful trials of such vehicles, which have for some time past been conducted in large business centres by extensive users of horse-drawn vehicles, and with the amount of capital actually appropriated by some of these enterprising but practical-minded firms for replacing the whole or a part of their horse equipment with electrically propelled vehicles.

Mr. Maxim holds that the electric carriage, like the trolley system for tram traction, has not only satisfied the expectations of its supporters, but has already opened out a field far in excess of their original hopes. To this fact is due the increased prominence awarded to electricity abroad, in the home of the oil-motor carriage. This development and introduction of electricity, as compared with other motive powers, is most remarkable, and surpasses any prediction that could have been made a year ago. At the recent Paris

cab contest, the most complete and practical series of tests yet given to any class of vehicles, 11 out of 12 competitors used electricity, and it is generally recognised that this is pre-eminently the power for the congested traffic of large cities. "As a result of this cab contest," says Mr. Maxim, "the entire Paris cab system will substitute electricity as a motive power before the close of the present year."

The attention of central station managers is called to the improved and improving status of the new industry, especially as in many localities it offers a solution to the problem of approximating to a continuous day load, or a tolerably level load factor.

In regard to the form of storage battery to be used for automotric traction, it is pointed out that one with "pasted" plates will probably prove to be the best from the point of view of high capacity; but that there are objections to all the existing cells of this kind, on the score of delicacy and short life. Whilst, therefore, it is quite probable that a cell of the Faure type may be devised to combine durability with high capacity, foremost American manufacturers, including the Pope Manufacturing Company, have almost universally adopted the combination form, in which the peroxide plates are of the Planté type.

Mr. Maxim's conclusions as to the requirements in the case of batteries for traction are well founded and deserving of careful consideration. To be of value for this application an accumulator should have a capacity of from 3·5 to 4 ampere-hours per pound of cell complete. This is in the case of a battery giving during discharge a mean P.D. of 1·9 volts; if the potential were lower, the capacity would require to be proportionately increased. The rate of discharge should not be lower than 1·3 amperes per pound of cell; and it should be possible to increase this rate up to 4 or 5 amperes per pound for short periods, without injury to the cell. The time requisite for a complete re-charge should not be much above three hours. With a battery fulfilling these requirements, a distance of 35 miles can, according to Mr. Percy Maxim, be traversed with an electric phaeton seating two people, without running down the battery to an injurious extent. But, in making such a statement, the weight of the battery which will maintain the requisite power over this distance, and also the speed of traction, should assuredly be specified. These very essential particulars are here omitted; although, from data given further on in the paper, we may calculate that the weight of battery must be 28·6 lbs. per ton-mile; whilst the ratio $\frac{\text{ampere-hours}}{\text{amperes}} = \frac{4}{1{\cdot}3} = 3{\cdot}1$ gives us time in hours, and $\frac{35 \text{ miles}}{3{\cdot}1 \text{ hours}} = 11{\cdot}32$ gives us the required speed of traction in miles per hour.

The journey of 35 or 36 miles—the latter being the normal distance in the case of the Paris electric cabs—can be, and has been, greatly surpassed by the use of high capacity cells of short life. A run of 92 miles, without re-charging the battery, has been reported from Paris, but the competition to realise such long journeys uninterruptedly is generally condemned by American engineers as removing the electric carriage too far from the field of practical utility, by the use of a battery incapable of withstanding rough usage, and economically useless by reason of its short life. The competition in question enables some firms in Paris to realise adequate profits in spite of the frequent renewals of the short-life cells; but the conditions which admit of this practice are plainly of a temporary nature.

Mr. Maxim states that the usual American practice is to equip a vehicle with 44 cells in vulcanite receptacles, four groups being formed by boxing together sets of 11 cells. The four batteries, in parallel, are charged from a 110-volt circuit, and three different speeds can be obtained by varying the grouping of the batteries and the consequent voltage at the motor terminals. Thus, with all four groups in parallel, 22 volts, approximately, are obtained; when two sets of two batteries in parallel are connected in series, 44 volts and a double speed are approximately realised; and, with all the cells in series, the voltage approximates to 88.

The motors are generally in series, but sometimes two motors on the same carriage are mechanically separate, each being geared to its own driving wheel. In this way an "electrical balance" is obtained between the driving wheels, and the alternative of a "mechanical balance" is obviated. In special cases this arrangement is advantageous.

Mr. Maxim takes for illustration a single-seated "Columbia" phaeton, which, he says, may be regarded as the standard of the day in its own field. It is described as follows:—The weight is, approximately, 2,000 lbs., 45 per cent. of which is due to the battery. The controlling apparatus consists of a foot lever connected to a band brake, a steering lever at the driver's right hand, the controlling lever at his left, a push button for an electric signal bell in the controller handle, and a foot reversing lever to be used only for backing. This carriage is at all times under the perfect control of the driver, can be turned in a 26-feet circle, and can be stopped on the level, when going at the rate of 10 miles an hour, within 25 feet from the point of application of the brake, supposing the occasion to warrant the wear upon the tires. The manipulations can be conducted with ease by persons without previous experience.

The recharging of the battery, after complete discharge, can be effected within three hours, the charging current for the battery used with this vehicle being 40 amperes, *i.e.*, 10 amperes for each set of cells in parallel. The batteries can be charged within the vehicle, but it is advisable to remove them, so that they may be under inspection. Automatic arrangements, in which a recording wattmeter is combined with a cut-out magnet, have been employed with success for cutting out the battery when charged; but these are found to be unnecessary when the charging is in experienced hands. In regard also to the condition of the batteries during the run, a little experience allows of its being inferred with tolerable accuracy from the diminishing speed, slight as this may be. It has been found by experience that the average coachman or driver becomes competent after a week's instruction to take charge of the carriage.

A considerable portion of Mr. Maxim's paper is devoted to the delivery business, represented in our metropolis by Messrs. Pickford & Co. and Messrs. Carter, Paterson & Co. The following data are given in connection with a delivery waggon, which is considered a good example of the dry goods type:—Total weight, loaded, 4,500 lbs., including two drivers and 1,000 lbs. of useful load; maximum mileage, 25; weight of batteries, 1,300 lbs. The expense of running this waggon

for two 15-mile trips would be that of 13·5 kilowatt-hours; and the yearly expense, for 300 working days, would be that of 4,050 kilowatt-hours. Now, it would appear from data obtained in the large eastern cities, that the cost of stabling one delivery horse at the owner's stable, together with the cost of shoeing and of repairs to harness, amounts to 250 dols. per annum. But an electric delivery waggon, with the two battery charges, can do the work of two horses, of which the maintenance would be $500, or, say, £103, per annum. Since this sum would allow of payment for electrical energy at the rate of over 6d. per kilowatt-hour, the conclusion seems justified that "any reasonable price for power would leave a considerable margin in favour of the electric carriage."

With regard to the relation of such vehicles to a charging station, it is anticipated that the former would generally start in the morning with batteries that had been charged overnight. But, after a first trip, recharging would be required; and about mid-day there would probably be more or less of a "peak" on the central station load line. This would be followed by an afternoon load, and by another peak at the close of the day. This applies more particularly to the routine of some large firms; but the use of electric waggons by a large number of small concerns worked under different programmes ought to effect a day load approximating to a fair degree of constancy.

Mr. Maxim considers that the operation of a cab or omnibus system would work still more to the advantage of the central station, and that in many places, especially in localities where, for æsthetic reasons, the trolley line is excluded, the demand for omnibus service is without doubt a real one, and will, within the next 12 months, call for the equipment of many such lines. But their success must rest in a measure upon the co-operation which central stations may afford; and it would seem that the desirability of increasing the day consumption of power, as well as the magnitude of the ultimate demand, would invite the most favourable consideration of those who have the management of such stations.

A suggestion which long ago was made in this country is about to be carried into effect in New York—that of a so-called "hydrant" for charging traction cells *in situ*. This is now being perfected by a prominent electric company, and consists of a coin-controlled, or "penny-in-the-slot" mechanism, with a wattmeter, voltmeter, rheostat, switch, and terminals.

Several central station managers have already led the way in the direction above indicated—as, for instance, at the station of the Central Railway and Electric Company, New Britain, Conn., where facilities for charging the cells of itinerant electric vehicles were provided nearly two years ago.

The Telegraphists.

No one can blame the telegraphists for endeavouring to better themselves, but it may be doubted if their position is really a very strong one, or whether their case has been put forward in a manner which can command admiration. Mr. Hanbury may be wrong in describing telegraphy as "only a superior kind of typewriting," and in stating that "sorting required more skill than did the ordinary telegraph work." The telegraphists on the one hand have urged the importance of their work, and on the other hand have done a great deal towards minimising its importance. They have asked for increased pay, and have striven with success, to get the technical examinations to which they were subjected, abolished. If their services required the high skill they claim, then those who were capable of showing this high skill should have had no difficulty in passing a technical examination. Their position would then have been almost unassailable. They could have said, "You have shown the importance of our position by requiring us to qualify for a technical examination which did not originally exist; we have worked for and passed this examination, now pay us accordingly." It could not have been contended, we think, that the test was a very severe one (according to the schedule which has been shown to us) and its abolition was, we think, a departmental mistake from the point of view of obtaining a highly efficient service, and it was a disastrous abolition to the argumentative telegraphist agitator. Higher qualifications, higher pay, is all right, but lower qualifications and higher pay is hardly so. There is, we think, also something in Mr Hanbury's contention that a higher class of men than is requisite for the efficient discharge of the work of a telegraphist enter the service and may suffer accordingly. That the Commissions which have dealt with the complaints have been properly constituted may admit of doubt; it is an extremely difficult thing to obtain a tribunal which shall be really satisfactory. The wrong men are often called to give evidence, *i.e.*, men whose acquaintance with the subject is imperfect; whilst those who do know are left unquestioned. The agitators call for a Parliamentary inquiry, if such were granted would the decisions of the same be accepted?

The Paris Exhibition.

The French Exhibition, to be held next year, is not attracting from English electrical engineers the attention which it should do. It is different with the Americans, and we are disposed to think that English manufacturing engineers should take advantage of this Exhibition to show of what they are capable. The national character for solidity ought to prove in English construction that the nominal or rated capacities which are used are much less than are allowed by foreign makers, and in competitive work this must often tell unfavourably unless English machinery is known. Paris offers the opportunity for doing this. In the January number of the *Proceedings of the American Society of Civil Engineers*, considerable space is allotted to a paper by an eminent American engineer, Mr. E. L. Corthell, who has been in Paris taking notes. As electrical science is to be the keynote of the Exhibition, the electrical building will be the most striking object. It is shown in a bird's-eye view standing in the centre of the Champs de Mars. The total area of the Exhibition will be greater than in 1889, though the site is practically the same. The additional area will be that on the right bank of the Seine, now occupied by the old Palace of Industry, soon to be removed. There will also be constructed a new and permanent bridge across the Seine. This is remarkable as having an exceedingly flat arch with a ratio of rise to span of only 1 : 17·12, giving the great thrust of 288 tons per square metre. A movable sidewalk is to be constructed, one platform moving at six miles per hour, the other at three miles per hour. But as there will be regular stations, passengers will need to alight at these. The speed of travel from place to place can easily be 10 miles per hour with a fair walker. The motive power is to be electrical and rollers are to be India-rubber covered for silent running. Doubts are thrown on the elevated position of this moving platform, if only on account of the serious obstruction of the view. The ascent of a staircase is also an objection. Though only narrow, 4·26 and 2·62 feet wide respectively, the platforms are expected to accommodate 50,000 passengers per hour in its length of 2·6 miles. We would urge upon English manufacturers the desirableness of putting in an appearance at this Exhibition. Because they are now so busy is no reason that they should neglect so useful a means of becoming known. Americans mean to push their own interest at Paris, and they have great experience in electrical work, but we do not believe that their productions are so solid as our own, nor are they better made or finished.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

In the *Elektrotechnischer Neuigkeits-Anzeiger*, Nos. 9, 10 and 11, there appears a mathematical investigation by Br. Böhm-Raffay on the question of insulated return feeders, which will be of considerable interest to electric traction engineers. The corrosion of iron structures by ground return currents has now become in America a very serious drawback in connection with trolley lines. The insulated return feeders appear to be the only thorough means of combating this evil, and consequently they demand the careful attention of engineers in this country while electric traction is yet in its infancy. We consider it desirable, therefore, to give a somewhat full account of Böhm-Raffay's investigation, which moreover does not admit of much abridgment.

The aim of the article is to give simple formulæ or where possible graphical methods of determining the section and volume of the return feeders.

I.—Determination of the Potential Drop.

If an insulated conductor of resistance R carries a current C, the drop of potential Δ at its end is given, as is well known, by the expression $\Delta = C\,R$. If the conductor is homogeneous and of uniform cross-section, and its length is L, the loss of potential at any distance x from the initial point will be $\Delta_x = C\,R\frac{x}{L}$, and the potential gradient along the conductor will be represented by a straight line whose inclination α to the axis L is given by the formula

$$\tan \alpha = \frac{C\,R}{L}.$$

If the whole current is not communicated to the conductor at one end, but only $\frac{C}{2}$ and $\frac{C}{2}$ at the middle, the loss of potential in the two halves will be $\frac{C\,R}{4}$ and $\frac{C\,R}{2}$ respectively, and the total loss in the whole conductor will be $\frac{3}{4}\,C\,R$.

The potential gradient now becomes a broken line; and it is evident that the total loss of potential in the conductor is smaller, the greater the number of equi-distant feeding points in the conductor.

In order to investigate the general case, let us suppose that the conductor is divided into n equal parts, each of the resistance $\frac{R}{n}$, and let each point of division be fed with a current $c = \frac{C}{n}$.

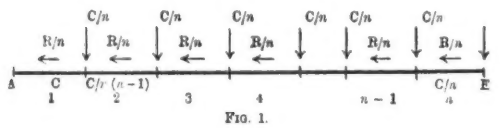

Fig. 1.

If we number the sections from left to right, the loss of potential in each part comes out as follows:—The first section must carry the whole current, while every following section carries always $\frac{C}{n}$ current less than the previous. The loss of potential in each section will therefore be

In the first section $\delta_1 = \frac{C\,R}{n}$

„ second „ $\delta_2 = \frac{C}{n}(n-1)\frac{R}{n}$

„ third „ $\delta_3 = \frac{C}{n}(n-2)\frac{R}{n}$

and „ last „ $\delta_n = \frac{C}{n}\{n-(n-1)\}\frac{R}{n} = \frac{C\,R}{n^2}$

The total loss of potential between the ends of the conductors is obtained by summing the expressions on the left-hand side, which form an arithmetical series.

$$\Delta = \Sigma\,\delta = \frac{C\,R}{n^2}(1+n)\frac{n}{2} = \frac{C\,R}{2\,n}(n+1).$$

If the number of feeders, n, is infinitely great, in which case c will be infinitely small, then $\Delta = \frac{C\,R}{2}$ and the loss of potential between the ends of the conductor, when it is fed uniformly along its whole length, will be only half the loss which occurs when the whole current flows through its whole length.

An analogous case occurs in the theory of beams. When a cantilever of length, L, fixed at one end is loaded, at the other end with a weight, W, the greatest bending moment is W L; when the same weight is distributed uniformly along the whole length of the beam, the greatest bending moment is $\frac{W\,L}{2}$.

In an electric railway with considerable traffic, n is always a large number and the formula for the potential drop $\Delta = \frac{C\,R}{2}$ may be taken as sufficiently accurate. The variations of the current at the feeding points in an actual railway are so great as to make errors introduced by the use of the formula $\Delta = \frac{C\,R}{2}$ of no importance. C is here the current at the central station and R the total resistance of the rails. If we take, for example, a 10 km. track, with moderate gradients, and a 5-minutes service, running at 10 km. per hour, the number of cars will be 24 and $\Delta = \frac{C\,R}{48} \times 25$, which is only 4 per cent. different from what would be given by the formula $\frac{C\,R}{2}$: even if we take the case when two cars meet and $n = 12$, the difference between $\frac{C\,R}{24}$ 13 and $\frac{C\,R}{2}$ is only 8 per cent.

If the current is uniformly fed to the conductor the potential gradient is a parabola, the equation to which is $y^2 = \frac{2\,L^2}{C\,R}x$. The parabola passes through one end of the conductor and the apex lies vertically above the other end. In the above equation the apex is taken as the origin of co-ordinates and the above-mentioned perpendicular as the axis of abscissæ.

Hitherto we have assumed that the conductor is completely insulated. This is, of course, not the case with the rails of an electric railway used as a return; hence the corrosion of water and gas pipes and other ills.

The injurious effects are greater, the greater the potential difference between the rails and the ground.

The potential difference will be greater, the greater the current which the rails have to carry.

To reduce the drop of potential in the rail return, and between the rails and the ground, insulated return feeders are made use of. The influence of these return feeders on potential gradient of the rails will now be investigated.

The central station is supposed to be at one end of the line. The two ends of the line are supposed to be connected to the dynamo in the central station, the one by an insulated cable, and the other by a resistance equal to that of the cable. It is assumed that half the current supplied to the rails will flow to each of these two conductors connected to the end of the rails. Since each half of the line has a resistance $\frac{R}{2}$, the maximum potential drop from the middle of the rails will be $\Delta_1 = \frac{C\,R}{8}$. This reduces the drop to $\frac{1}{4}$ of that which occurs when no return cable was used.

An analogy from the theory of beams also comes in here. When a uniformly loaded beam is supported at both ends, the centre is $\frac{W\,L}{8}$. The number of supports of a uniformly loaded beam correspond to the number of feeders and the bending moment to the potential difference at any point of the rail. The analogy appears to apply generally.

If the whole line is divided into m sections by the terminal connections of return cables, the maximum potential drop between any two cables will be

$$\Delta_m = \tfrac{1}{2} \frac{C}{2_m} \cdot \frac{R}{m} = \frac{C R}{8_m{}^2}$$

a formula which may be deduced by calculating the maximum bending moment in a beam of length R, with a uniformly distributed load, C, and divided into m equal sections by supports (N.B.—The beam is supposed to be cut through at each support).

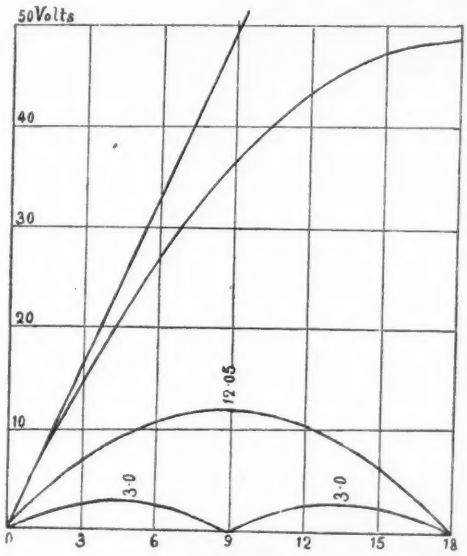

Fig. 2.

In fig. 2 these potential gradients are graphically represented for a particular case. A horizontal line is assumed, 18 km. in length, upon which 36 cars, taking each 15 amperes, run. The resistance of the rail return is 0·01 ohm per kilometre. The line is a double track, and the moment is chosen in which two cars meet, therefore, $C = 36 \times 15 = 540$ amperes, $R = 0{\cdot}01 \times 18 = 0{\cdot}18$ and $n = 18$. The potential drop when no return cables are used

is $\Delta = \dfrac{540 \times 0{\cdot}18}{2 \times 18} \times 19 = 51{\cdot}3$ volts, or (approximately)

$$\Delta_0 = \frac{540 \times 0{\cdot}18}{2} = 48{\cdot}6 \text{ volts.}$$

If one cable is connected to the end of the line, since the number of supply points (17) is uneven,

$$\Delta_1 = \frac{540 \times 0{\cdot}18}{8} = 12{\cdot}15 \text{ volts.}$$

With another cable connected to the middle of the line

$$\Delta_2 = \frac{540 \times 0{\cdot}18}{8 \times 2^2} = 3 \text{ volts.}$$

With two intermediate cables

$$\Delta_3 = \frac{540 \times 0{\cdot}18}{8 \times 3^2} = 1{\cdot}3 \text{ volts.}$$

II.—Determination of the Cross-section and Volume of the Copper.

Now to calculate the section of the copper, on the assumption that the fall of potential in each cable is the same, so that all the points of connection to the rails may be at the same potential, let there be, besides the cable to the terminus and the connection to the beginning of the line, m intermediate cables, which are connected at equi-distant points. The near end of the line is close to the central station, so that the length of the cable in this case is negligible. The line is divided into $m + 1$ equal sections by the m return cables, and the sum of the currents in each of these sections is

$$C_m = \frac{C}{m+1}.$$

Each cable carries, therefore, a current of $\dfrac{C}{m+1}$ amperes, while the current at the beginning and end of the line is, in each case, $\dfrac{C}{2(m+1)}$.

If the return cables are laid along the side of the line, the length of the first is $l_1 = \dfrac{L}{m+1}$; of the second $l_2 = \dfrac{2L}{m+1}$ and so on. If Δ be the permissible potential drop in the conductors, K the conductivity coefficient, s the cross-section of a conductor, then

$$\Sigma(s) = \frac{C_m l_1}{K \Delta} + \frac{C_m l_2}{K \Delta} \ldots\ldots + \frac{C_m l_m}{K \Delta} + \frac{C_m L}{2 K \Delta}.$$

Substitute, now, in this equation the values of $l_1, l_2 \ldots\ldots$ and we obtain

$$\Sigma(s) = \frac{C_m L}{K \Delta} \times \frac{L}{m+1} \{1 + 2 + 3 \ldots\ldots + m\} \frac{C_m}{2} \frac{L}{K \Delta}$$

$$\Sigma(s) = \frac{C_m L}{K \Delta} \times \frac{m}{2} + \frac{C_m}{2} \frac{L}{K \Delta}, \text{ and since } C_m = \frac{C}{m+1},$$

$$\Sigma(s) = \frac{C}{m+1} \frac{L\,m}{2 K \Delta} + \frac{C}{m+1} \frac{L}{2 K \Delta}$$

$$\Sigma(s) = \frac{C L}{(m+1)\, 2 K \Delta} (m+1) = \frac{C L}{2 K \Delta}.$$

Now, this last expression is a constant, since L and C for a given line are constant. It follows from this that "the total copper cross-section is the same whether one cable only is applied to the distant end of the line, or whether any number of cables are connected to equi-distant intermediate points."

In order to calculate the volume of copper in the return cables, it is only necessary to multiply each member of the first expression for $\Sigma(s)$ by l_1, l_2, &c.; then

$$\Sigma(\text{vol}) = \frac{C_m}{K \Delta} \{l_1^2 + l_2^2 + \ldots\ldots l_m^2\} + \frac{C_m}{K \Delta} \times \frac{L^2}{2},$$

substituting the values of l_1, l_2, &c., in terms of L and m

$$\Sigma(\text{vol}) = \frac{C_m}{K \Delta} \left\{ \frac{L^2}{(m+1)^2} + \frac{2^2 L^2}{(m+1)^2} + \ldots\ldots \frac{m^2 L^2}{(m+1)^2} \right\} + \frac{C_m}{K \Delta} \frac{L^2}{2}$$

$$= \frac{C_m L^2}{(m+1)^2 K \Delta} \{1 + 4 + 9 + 16 + \ldots\ldots m^2\} + \frac{C_m}{K \Delta} \frac{L^2}{2}$$

The part within the brackets is some of the squares of the natural numbers up to m, *i.e.* $= \dfrac{m(m+1)(2m+1)}{6}$

When this and the value for C_m is introduced into the formula,

$$\Sigma(\text{vol}) = \frac{C}{(m+1)^3} \frac{L^2}{K \Delta} \frac{m(m+1)(2m+1)}{6} + \frac{C}{m+1} \times \frac{L^2}{2 K \Delta}$$

$$= \frac{C L^2}{3 K \Delta} + \frac{C L^2}{6 (m+1)^2 K \Delta}$$

This expression has evidently a maximum value when $m = 0$, and a minimum when $m = \infty$.

It follows, therefore, that the quantity of copper required when one conductor is connected to the terminus of the line is a maximum; and when an infinite number of return cables is used it is a minimum.

The difference between the maximum and minimum quantities of copper is considerable. Making $m = 0$ in the above equation

$$\Sigma(\text{vol}) = \frac{C L^2}{3 K \Delta} + \frac{C L^2}{6 K \Delta},$$

i.e., the quantity of copper is 50 per cent. more with one cable than with an infinite number.

The value of the second member of the expression for the quantity of copper decreases very rapidly with the increase

of m. For example, using three return cables, the second member is only about 3 per cent. of the value of the first; using six returns it is only 1 per cent. It is not to be forgotten that the maximum potential drop with one cable is $\frac{CR}{8}$, while with three and six it is $\frac{CR}{128}$ and $\frac{CR}{392}$ respectively. Therefore, besides using less copper, there is in the latter cases, a very much more favourable potential gradient.

(To be continued.)

OZONE AND FOGGED PHOTOGRAPHIC PLATES.

By E. ANDREOLI.

I READ some years ago in an extract from the Dublin Chemical and Philosophical Club that Dr. Emerson Reynolds stated that the latent image (*i.e.*, the image before it is developed), when submitted to the action of ozone, was completely obliterated; not only was it impossible to develop it, but a second image might be re-taken in the camera upon the same plate. This, he said, is against the mechanical theory of photography and proves that it is due to chemical changes in the sensitive film.

No doubt this action of ozone on sensitive photographic plates is not generally known.

If ozone destroys a latent image on a photographic plate, why should it not restore to a fogged film its primitive properties?

Why should it not oxidise the silver compounds which the white light has reduced?

Starting from this fact, that, according to this statement, ozone destroys the effect of the exposure of a photographic plate to light, I made the following experiments a few days ago:—

In the dark room two dry plates were half wrapped in tinfoil and black paper and then the non-protected films were for two seconds exposed to the white light of the sun, which on that day was very brilliant.

Under ordinary circumstances the part of the film which has been struck by daylight would be inevitably fogged; it would no longer be able to take even the faintest image, and when dipped in the developer would simply turn black, because light has spoilt it and it has become utterly unavailable for photographic purposes.

I ozonised the plates during about four minutes, and after this I placed them under a Röntgen tube, and in the usual manner I photographed an eye-glass in its case. On the day before, I had exposed two plates to the light of an incandescent lamp and ozonised them afterwards, and this first experiment had been somewhat encouraging; two following ones, however, had been a complete failure; there was an image on the halves which had not seen the light; the other halves were as black as pitch.

The experiments to which I refer now were successful in that sense that the image of an eye-glass in its case was visible on the whole surface as if the silver compounds of one half of each plate had not been acted upon by light. I will not pretend that the two halves of each plate were equally transparent; this is a matter of detail; with more ozone (I had only four small luminous tubes) there would be no difference between the two parts of the plates, and the image would be as sharp on the halves which have seen the light than on those which have not seen it.

Captain A. W. Abney in his "Instructions in Photography" speaks of general fog, by which he means the fog produced in development, caused by the partial reduction of the silver salt all over the film. This, he says, is probably due to the decomposition of the gelatine by long cooking, the products of which in the presence of a developer are apt to react on the silver salt and produce a partial reduction on it. The production of this kind of fog and electrical disturbances in the atmosphere are apt to go together.

Another fruitful source of fog is the light admitted to the plates during preparation or development. Whatever may be the cause of the fog, if the emulsion be not hopelessly at fault, or if the plates have seen the light, according to Captain Abney, who does not suggest the use of ozone, the remedies are: the use of potassium bichromate or the addition of cupric chloride or of a few grains of ferricyanide of potassium with a little bromide of potassium.

Prof. R. Meldola is, I think, the only specialist in photography who has treated this question of the disappearance of the invisible image, which he considers as a photo reduction product. "Such a compound," says he ("Chemistry of Photography," page 197), "like all reduced products, is susceptible of oxidation. In accordance with this view of the composition of the invisible image, it is found that the latter can be destroyed by oxidising agents . . . . such as nitric acid, the chromates, permanganates, metallic perhaloids, which are equally effective in destroying the invisible image."

"It is generally believed also (p. 205) that atmospheric oxygen (or ozone) plays a part in the obliteration of the invisible image. The destruction of the image may, in such a case, be due to indirect rehalogenisation, that is to say, the oxygen or ozone may oxidise the halogenised sensitive, and so liberates the halogen, which then attacks the reduction product."

The above-described experiments confirm the statement made by Dr. Emerson Reynolds on the erasure by ozone of the image impressed on the film, and show the possibility of restoring to the plates their sensitiveness.

Beyond the interest which they present from a scientific point of view, they did not seem, however, to present any particular character of usefulness; but a friend has suggested that in the works where photographic plates are manufactured, the ventilation by ozone may prove beneficial in removing the many causes of reduction which fog the films.

I intend to carry out a series of exhaustive experiments to ascertain the regenerating power of ozone on photographic plates which have been submitted to a more or less prolonged exposure to the daylight, and I will have for the readers of the ELECTRICAL REVIEW some blocks showing the results of the resuscitation by ozone of photographic plates killed by daylight.

CORRESPONDENCE.

"Wireless Telegraphy in 1849."

Mr. J. W. Wilkins's interesting letter published in your issue of the 24th ult. carries us back to early electrical days, 1849, but I can well recollect when a youth, and having the privilege of fishing in the Serpentine River in the Kensington Gardens, seeing some gentlemen with wire and battery doing something at the water's edge, first on one side then on the other; this would be about 1843.

Many years after this I was informed by Sir Henry Tyler (late of the Board of Trade) that he was the gentleman who was trying experiments to send a current across the water without a wire "used as a conductor."

No doubt he could tell us the result of his experiments, but the principle he worked on is very different to that on which the present experiments are being made.

C. E. Spagnoletti.

Central Station Voltmeters.

Referring to Mr. C. B. Nixon's inquiry in your issue of 10th ult., I would point out that the voltmeter used in the Folkestone Central Station for paralleling is of the Kelvin moving coil type. It is arranged with its zero at the middle of the scale, and the design of the instrument is such that the widest divisions are given at each side of zero. The instrument is one with a single circuit, the ends of which are connected to the terminals. One of the instruments at Folkestone is used when a dynamo is being started up, to indicate when the voltage of the dynamo is the same as that of the circuit on to which it has to be switched. A double-pole voltmeter switch is arranged to put the instrument across the main dynamo switch. The instrument indicates zero when there is no difference of potential across the switch. If the voltage of the dynamo is higher than that

across the buss bars, then the pointer will be deflected to the "dynamo" side. On the other hand, if the voltage of the bus bars is higher than that of the dynamo, the pointer will be deflected to the "buss bar" side. The sensibility of the instrument is such that 20 volts gives a deflection over the whole scale on each side of zero, and the internal resistance and the winding of the coils enable it to withstand the total voltage across its terminals without damage.

James Ferguson,
Manager, Electrical Department,
James White, Glasgow.

The Telegraphists and Mr. Hanbury.

May I call your attention to the following statements made by Mr. Hanbury, M.P., in the House of Commons, February 20th (Monday), 1899:—"Telegraphists talk as if operating work was skilled work of a superior kind, but it was only a superior kind of typewriting." In addition, Mr. Hanbury, in reply to a question by Mr. Spicer, said he did not consider the telegraphists were performing more efficient work than in 1870. The postal telegraph clerks desire to combat these statements, and wish to obtain an expression of opinion from a number of gentlemen, who, either in their capacity as editors of newspapers, or electrical engineers, have been able to form definite opinion regarding the skill required of a telegraphist. If you could state, however briefly, whether your views coincide with those of Mr. Hanbury, I shall be very grateful.

E. H. C., *per* S. W. Belderson,
Parliamentary Secretary, Postal Telegraph Clerks' Association.

[As stated on a previous occasion, our columns are open to the discussion of the position of the telegraphists. We refer in a leaderette to the general subject.—Eds. Elec. Rev.]

The Kilduchevsky Mega-Telephone Transmitter.

Sending to your valuable paper the *bonâ fide* description of my telephone transmitter and the results obtained thereon, I expected to receive from you a fair and technical criticism, but I regret to notice that you have stated some misleading points in your article, viz.:—

1. Never was it "stated" that *dust*, *moisture* and *derangement* can *oxidise* carbon; it is *obvious* that the sealing of microphonic contacts in a vacuum will prevent oxidation.

2. The gauge of the wire of the 2,000 miles long overhead line was from 4 to 5 millimetres diameter, but I always understood that the total resistance and capacity are only interesting in the telephone tests, not the gauge only.

3. The tests in this country were carried out on an artificial cable in which the essential electrical condition of a modern Atlantic telegraph cable were accurately reproduced. For the purpose of comparison, two of the most efficient telephonic transmitters were pitted against mine. Both had been previously tested to make sure that they worthily represented their respective types.

On bringing the section of the cable into circuit, with a resistance of 342·9 ω and a static capacity of 34·62 *m. k.*, the product being 11·861, the intensity of the two transmitters was much reduced, and the "Kilduchevsky" became marked by the best.

I believe that it was a fair test for all the three transmitters, as they were tested on the same conditions.

As to the novelty of my invention, the question is decided by the American and German Patent Office.

But I am of the same opinion as Mr. W. M. Mordey (Society of Arts, February 8th), that it is always the case for a number of people to say that they have done the same thing 20 years ago; the peculiar thing is, that those statements are made only after someone brings an invention to a success.

Paul Kilduchevsky.

[The exact wording of the description forwarded to us is as follows:—"The power of the current may be increased to any required extent without liability of oxidation of the contacts, and the same are protected from moisture, dust, and from derangement, and no packing can occur." To an expert doubtless, "total resistance and capacity are only interesting in the telephone tests," but all are not experts, and to such the 2,000 miles bare statement is most misleading. It is unfortunate that Mr. Kilduchevsky did not say of what type the "two of the most efficient telephonic transmitters" were. —Eds. Elec. Rev.]

The Fittings Censorship.

The letter which you have seen fit to publish from Mr. C. A. Clarke consists chiefly of a violent personal attack upon myself, and so far as it is this, it is a matter of not the slightest moment to me, and if it had been nothing more I should have left it unnoticed. There are, however, one or two statements concerning which my silence might be misconstrued.

It will be readily understood that in introducing so novel a course as the registration of fittings, it is impossible to foresee every contingency that may arise, and in one or two points I found it possible to modify the rules so as to meet the convenience of manufacturers without detriment to the interests of the Corporation or their consumers. I accordingly sent round on February 6th two circulars to all manufacturers whose addresses can be found in the directory; copies of these circulars I enclose in case you should care to find space to publish them.

Mr. C. A. Clarke is merely an agent, and not a manufacturer, and hence he did not receive these circulars, since only manufacturers are at present entitled to register fittings. It is obvious, therefore, that the registration and the provision of duplicate fittings does not concern Mr. C. A. Clarke in his business.

I have under consideration a further modification of the rules, by which agents and merchants will be allowed to register apparatus not manufactured by themselves. If I decide on this course, Mr. Clarke will receive a circular informing him of the fact.

There appears to be a great deal of misconception as to what the registration which I have introduced really is. All that is required is that fittings used shall conform to certain tests, and the actual fittings may be submitted, but in order to avoid the inconvenience of contractors having to submit the same kind of fitting many times over, I arranged that such fittings might be permanently registered on certain conditions, one of these being that samples were submitted in duplicate, one for testing, the other for show purposes. It will thus be seen that it is not obligatory upon any person to register the fittings, but they may do so if it suits their own convenience, and I find that the majority of manufacturers are gladly availing themselves of this.

As regards the alteration in the regulation as to flexible wire, it is quite true that I now give contractors the choice of employing wire insulated with pure rubber of a certain minimum thickness as well as with vulcanised rubber. I did this in order to bring my own regulations in harmony with those of the Institution of Electrical Engineers.

Mr. C. A. Clarke's statement that I have made private exceptions in favour of individuals is absolutely and entirely untrue.

C. H. Wordingham.

[Copy of Circular.]

Dear Sirs,—It having been represented to me that some hardship is entailed on manufacturers by requiring them to submit duplicate samples of fittings which are of an expensive character, I have decided to meet the convenience of the manufacturers by returning them one of the duplicate samples submitted, which has been subjected to our tests, retaining only one for reference, in all cases where the net selling price of the fitting exceeds 10s., if desired by the manufacturer.

I would point out that in the case of expensive fittings, it is not often that these are used in large quantities, and in issuing the new regulations I quite contemplated that these would be applied for under Form A, that is to say, that a manufacturer would not seek to register any very expensive apparatus, but would leave it to the contractor to apply in each particular case, where such expensive apparatus was fixed.

If the apparatus is used in such large quantities as to render repeated application under Form A necessary, it would then surely be worth while for the manufacturer to apply under Form B for registration.

By expensive apparatus I mean fittings costing, say, £5 and upwards.—Yours truly,

C. H. Wordingham,
Per W. M. and C.

[Copy.]

Dear Sirs,—Certain questions have arisen in connection with the granting of certificates of registration for fittings supplied through agents. I have to inform you that it is impossible to grant a certificate to any but the actual manufacturer of the fitting which it is sought to register.

In those cases where an agent sells fittings which, for trade reasons, it is desirable should be sold without the name of the actual manufacturer being disclosed to the public, I have no objection to treating both the application and certificate as confidential, provided that the manufacturer has no objection to this course. Thus, suppose an agent, A, sells fittings manufactured by B, the application for registration is signed by B, and the certificate is made out to B, but the samples are shown here on the sample board, and instead of being marked manufactured by B, are marked supplied by A.

Another point which has arisen is in connection with articles sold by agents who are necessarily without the original certificate granted to the manufacturer. As purchasers often require to see the certificate before giving an order for fittings I shall be happy to issue duplicate certificates for any fitting at the request of the manufacturer.—Yours truly,

C. H. Wordingham,
Per W. M. and C.

Shocks from Motors.

Should the frame of a motor be insulated or earthed?

We have recently seen how the many established rules disagree on this point, and it appears to me that the discussion at the I.E.E. meetings led to no unanimous conclusion.

A study of the possibilities under all conditions shows that an equally severe shock might be received under circumstances by touching a brush or terminal whether the frame were "insulated" or "earthed." With the former method, also, the mere touching of the frame might result in a shock, an impossibility, of course, with an "earthed" frame.

We have further to consider that direct coupling and driving through gear is a common necessity, and insulation under such circumstances would be out of the question.

I would therefore suggest that no effort be made in future to insulate the motor frame, and that if the voltage should exceed 200 an efficient earth connection be provided, and all live connections suitably guarded.

David Stevenson.

March 1st, 1899.

The Nernst Lamp.

Allow me to draw your attention to a mistake which occurs in "Notes" of your last issue. In giving particulars of the scheme of the Nernst Electric Lamp Company, you say that the same is acquiring the patent rights in the United Kingdom, whereas the proposed company acquires only certain colonial rights.

May I, whilst on this subject, point out that one does not, in view of counsel's opinion and of the publication of the Nernst blue-book, see in what colonies valid patents can now be obtained.

Surely it would have been easy for the directors of the Nernst Company to ascertain this, and to inform the public more fully.

That the promoters should have floated the company whilst matters are in such a problematic condition, is much to be regretted, and can only do harm to electrical enterprise.

. . . . I may add that I have given the Nernst lamp my attention for some time, and have made experiments with the same object in view. These have been so far quite satisfactory, and I can confidently state that, by the process I refer to, lamps of any candle-power and voltage can be produced consuming only 1·5 watts per candle. No preliminary heating is required.

F. Fanta.

Kilduchevsky Mega-Telephone Transmitter.

I note that your excuse for publishing a false statement regarding my tests of this transmitter is that it was contained in a MS. that somebody (name not given) was kind enough to send you. Can it be that anybody can get anything inserted in the Electrical Review at the cost of a postage stamp?

May I inquire why if, as you claim, you *had* heard of artificial cables without bobbins, your leading article condemned all such cables for telephone testing without reservations in favour of those innocent of inductive reaction? To have written that some artificial cables are suitable while others are not might conceivably have done good; to stigmatise all as bad surely justifies the reader in suspecting ignorance or carelessness.

Then you speak, in the same article, of "the all-important element of gauge," and say "a very bad telephone would work well through 5,000 miles if the wire were of sufficiently large gauge." Surely you must recognise that other things—metal, dielectric, mode of erection—have to be considered. Gauge alone would not compensate for errors in respect to these. Can the Electrical Review cite *any* authentic instance of even a very good telephone having spoken through 5,000 or even 2,000 miles? If not, why say that a very bad one will do so? The leader writer apparently had in his mind speaking through a resistance box with the equivalent resistance of 5,000 miles plugged out—a common trap for tyros.

Then the test through a looped wire which you so unequivocally condemn might be quite effective and conclusive. It all depends on how the looped wire is made up. If it goes and comes on the same poles or even on the same road or railway it is useless; if the return half is out of the inductive range of the outgoing half the loop will yield a good test. You do not hint at anything of this kind, but simply ban all loops.

Such leading (or rather mis-leading) articles cannot work for good.

A. R. Bennett.

[As Mr. A. R. Bennett can testify from his own experience, we do not insert all communications, even when the postage has been paid. As we point out on page 353, the statements were sent to us by the Kilduchevsky Mega-Telephone Syndicate, to whom Mr. Bennett gave a report.

Our leaderette did not condemn all artificial cables, otherwise the expression, "there is *often* a reaction between the bobbins," the meaning of which is obvious, we should think, would not have been inserted.

The phrase, "the all-important element of gauge," does not imply that gauge is the *only* important element, as appears to be imagined.

The Electrical Review cannot cite any authentic instance of telephone working through 5,000, or even 2,000 miles. It does not require to do so; the writer had *not* in his mind speaking through a resistance box.

The statement as regards working through a loop contains the words, "and without using earth," which Mr. Bennett has ignored. Carelessness to note such points as this "cannot work for good," to use Mr. Bennett's own words.

Finally, we may add that the writer of the leaderette has an intimate knowledge of experiments on telephone working, a knowledge certainly not second to that of Mr. Bennett himself.—Eds. Elec. Rev.]

LEGAL.

The Castner-Kellner Alkali Company, Limited, *v.* The Commercial Development Corporation, Limited.

In the Court of Appeal on Tuesday before the Master of the Rolls and Lords Justices Rigby and Vaughan Williams, the case of the Castner-Kellner Alkali Company, Limited, *v.* the Commercial Development Corporation, Limited, who carry on business at Charlton with interests in Birmingham and elsewhere was heard on appeal by the defendants from an order by Mr. Justice Bigham, sitting as a judge of the Chancery Division. The action was one brought by the plaintiffs who are the registered owners of letters patent granted to Mr. Carl Kellner for an invention of improvements in the electrolytic apparatus for decomposing alkaline salts, for an injunction to restrain the defendants from manufacturing or selling caustic soda or other alkali in infringements of their letters patent. The defendants contended first that the plaintiffs' patents were bad for disconformity, and secondly, they denied infringement.

Mr. Terrell, Q.C., Mr. Altbury, Q.C., Mr. McConkey and Mr. J. H. Gray appeared in support of the appeal, which was opposed by Mr. Fletcher Moulton, Q.C., Mr. Bousfield, Q.C., Mr. J. Graham, Mr. A. J. Waller and Lord Robert Cecil.

Mr. Terrell, in opening the appellants' case, said that his clients were appealing from the judgment of Mr. Justice Bigham, holding them liable for threatened infringement, and he thought infringement also of a patent taken out by Kellner in the year 1894, No. 20,259, for improvements in electrolytic apparatus for decomposing alkaline

salts. The subject to which the patent applied was a very extensive trade in the manufacture of caustic soda. That was a combination of the metal sodium with oxygen used in the arts of soap making, many hundreds of thousands of tons being used in a year. Caustic soda had always being manufactured from common salt, which was a combination of chlorine and sodium, and the problem in the manufacture of caustic soda was to get rid of the chlorine which was combined with the metal sodium and common salt, and to substitute for the chlorine oxygen. That was the problem to be solved. For many years that had been done and was still done chemically. Many years ago it was ascertained that you could decompose metallic salts by an electric current. You passed a current through a cathode through an electrolyte and through an anode with the result that the sodium was separated from the chlorine, the salt was decomposed, the metal was decomposed on the one side and the acid of the salt, or the chlorine or oxygen, was evolved at the other end of the apparatus. In that way metals were produced from salts. That was used in the process of electro-plating. As soon as that was understood it was obvious that the same thing could be done with chloride of sodium. You could by passing an electric current through chloride of sodium obtain metallic sodium at one end and the evolution of chlorine at the other end. But there was a difficulty because the avidity the metallic sodium had for oxygen was so great that as soon as it was formed by the electric process it was decomposed again. Sir Humphrey Davy discovered a fact which was the foundation for all the electrolytic propcsals for the decomposition of chloride of sodium, and that was that if you used a cathode which was composed of mercury, the mercury absorbed the metallic sodium and protected it from the action of the water contained in the fluid for a certain time, so that by way of electrolysis you could obtain metallic sodium, but you obtained it alloyed by a large percentage of mercury. Subsequently to that discovery a great many attempts were made to utilise this discovery in the arts, and he (counsel) would have to deal with those attempts at some length, because he wanted their Lordships to exactly understand what it was that Kellner invented, and why he said that patent was bad, and why he said that the defendants had not infringed it.

Lord Justice Rigby: You say both do you?

Mr. Terrell: Yes. I say his patent is bad for disconformity.

The Master of the Rolls: That is a question of construction.

Mr. Terrell: Yes, a question of construction, having regard to the knowledge of the art at the time the specifications were filed. Then I say the plaintiffs' patent is bad for want of subject-matter; and then I say that I have not infringed it. The learned counsel said that the first attempt at putting Sir Humphrey Davy's process into use was by a patent taken out by Atkins and Applegarth, with which it would be necessary to trouble their Lordships. Atkins and Applegarth took out their patent in the year 1890, No. 20,768. Their Lordships had before them an enlarged drawing of that patent—This process was eminently calculated to waste mercury, and eminently calculated to waste labour in the transference of the loaded mercury. This process, therefore, came to nothing, but it was illustrative of the first practical attempt which was made to utilise the process which had been described by Sir Humphrey Davy.

The Master of the Rolls: You say wasteful in mercury.

Mr. Terrell: Yes; and in labour and energy in carrying the process to a practical result. The apparatus was also necessarily complicated and imperfect in its operation. The next process was that of Hermite and Dubosc, 1891, No. 21,959. That also was eminently calculated to be wasteful in mercury, having regard to the value of the mercury used in comparison to the value of the product. It was also an intermittent process, the mercury being first charged and then discharged, and always kept in a state of flow. Then came Jensen's process of 1893. This was a continuous process, but involving the mechanical carrying of the mercury from one vessel to the other. He would next deal with Castner's process. In considering that process, he would point out that the salt was decomposed by the electric current pure and simple. There was nothing to arrest it; but when they got to the other side of the process the amalgam of mercury might be decomposed by water only, or arrested by an electric current. Now, it was very essential in this process that the richness of the amalgam should be kept very nearly constant. If the amalgam was freed from mercury very much quicker than the taking up of mercury, it was presented to the action of electrolysis at different stages of richness, which was undesirable, and not economical to work. The mercury amalgam, if allowed to be decomposed by water alone, required a very much larger surface of water to discharge it from its sodium than it did the electrolyte to charge it with sodium. If, on the other hand, the current was employed through both sides of the process, the discharging process was much quicker than the charging, so they again got their mercury presented with different richness to the process of electrolysis, and Castner appreciated that, and Castner achieved what they had now got for the first time—a really continuous process. He used a circular chamber, divided into two halves by a diaphragm, or partition, which did not quite touch the bottom of the chamber. Enough mercury was placed in the bottom to seal the two halves one from the other. In the one half salt solution was placed, and in the other water. The mercury, when charged with sodium in the first half, was removed to the other half by means of a paddle with a rotary motion, constituting one continuous flow. But inasmuch as the two chambers were of the same size, he found a difficulty in this, that if he passed an electric current entirely through both, he got discharge much quicker than charging, and if he passed it through one alone he got the discharging much slower than the charging. So he separated out his electric current. He got a dynamo giving 90 amperes and a dynamo giving 10 amperes, and so arranged his currents that he balanced the thing. Their Lordships would see that Castner had got essentially a continuous process, in which the mercury was continually passing from one side of the apparatus to the other side by the movement of the paddles, and a process eminently calculated to maintain the mercury at one point of richness. There were two vessels of mercury travelling from one to the other in one continuous flow, continually absorbing sodium, and continually discharging it. Castner showed that he might pump his mercury. The next patent their Lordships would have to consider was that of Sinding and Larson. There there was a salt solution and a metal bath of a cup shape, caused to be revolved by pulling at the top. As it revolved, the mercury was taken from the inner side of the vessel, was switched up, and passed over the amalgamated surface, and dropped down on the other side. This process could not be made into a commercial success—at least that was what the evidence showed. The evidence showed that none of these patents were practically used, with the exception of Castner's, which was a practical apparatus, and which was bought by the plaintiff company. They did not, however, sue the defendants upon that, but sued them upon the Kellner patent, which they bought afterwards. The plaintiffs did not use Kellner's themselves, but some modification of Castner's. He had given their Lordships, he considered, enough in the way of specifications to show what was the state of the art when Kellner filed his provisional specification. The state of the art was this. It was well known that mercury would absorb sodium, and that sodium could be protected by the mercury from the too rapid action of water. It was well known that it could be done by a continuous process by pumping the mercury, or by revolving the mercury as Castner had done. It was well known that they could, in that way, maintain the mercury at a particular definite stage of richness. The question then arose whether Kellner knew anything about Castner when he filed his specification, and if he did, or even if he did not, what did he mean by his specification. Looking at the language of the specification, he thought it was probable he was aware of Castner at the time he filed it. Kellner preferred to improve on the Castner process, by allowing the mercury to remain stationary relative to its containing vessel, and his claim was for "an apparatus for the electrolysis of alkaline salts with the aid of a stationary mercury cathode." Instead of a chamber divided into two halves, he used a large chamber called the combining chamber which contained water and mercury, and a smaller chamber or series of chambers called the decomposing chamber containing the salt solution. These chambers were in the form of bells, and were so placed as to dip into the mercury which thus sealed them, separating the water from the salt solution. The bells were moved to and fro slowly so that the mercury should be exposed alternately to the action of the salt solution and the water. Notches were cut in the edges of the bells to let the mercury pass, and alternatively grooves were cut in the bottom of the outer vessel. In another form the bells were arranged radially, and either the bells or the outer or combining chamber rotated. In Rhodin's patent they began by taking a containing vessel which was the largest vessel of all. That vessel contained water, and in that was put a bottom with the ribs radiated, the object of those ribs being that as the apparatus rotated the mercury flowed from the inner side to the outside. It was to give a radial action. The next thing was a china vessel. There was a succession of bells. On the top of the bottom which contained the mercury was water. The mercury was supposed to cover the ribs. When this went down the ribs of the bells made a seal between the inside of the bells and the outside. They dipped into the mercury. There was a large extent of water compared with the surface of salt solution exposed to the operation. The salt solution could not get out because the mercury was sealed. In the anode was a battery and carbon poles, through which an electric current was passing, the poles going into the salt solution. As they operated in the salt water the mercury at the bottom got charged, and then a rotation was given to the top of the apparatus only, and that rotation being given the mercury was first under the influence of the salt solution and then under the influence of the water solution, and a radial movement was given to the mercury, so that it flowed out. The mercury was in constant movement, first being operated upon by the electrical action in the salt solution and then being pushed out by the radial movement all round where the water was and there decomposed. The inventor in Rhodin's patent did not rely on an auxiliary current of electricity for the purpose of obtaining his electrolytic and decomposed action, but limited his area to water contact. It was not true to say that the mercury in Rhodin was stationary, because it was intentionally given a radial action, not only to enable it, so to speak, to expose a patch to the action of the electric current and then a patch to the action of the water, but to cause a constant flow of mercury, and so as to expose a large quantity of mercury to the action and flow of water. Under all these influences you might have in one sense a stationary mercury and in another sense movable mercury. What they had to inquire into was as to the substantial operation of the apparatus. In Castner the movement of the paddles was exceedingly slow. In Castner the mercury was pushed under the bells from place to place by the paddles. In Kellner, the mercury was carried from bell to bell by the friction of the bottom of the vessel which contains it. Kellner's aim was to get mercury from one bell to another. He (counsel) admitted that if Kellner had been the first to do anything of the sort it would have been difficult for him (counsel) to show that the variations did not involve infringement of Kellner. But Kellner was only doing that which a great many people did in another way. The essence of Rhodin's patent was the rapid movement of the mercury outwards, but the essence of the Kellner invention was to have it rich and then impoverished, then made rich again and impoverished again. What Rhodin said was "move your mercury as rapidly as possible and you will find that you will maintain that definite point of richness at which the operation is best conducted."

Mr. Terrell said that the substance of Mr. Justice Bigham's judgment was on the words "stationary, mercury, cathode," in the Kellner specification.

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The Master of the Rolls: As I understand it your mercury is as stationary as their's?

Lord Justice Rigby: Your cathode, you know, is in one sense stationary, and in one sense it is not?

Mr. Terrell: Yes, although it is stationary in space it is mercury, the particles of which are constantly changing their relation to each other. When your Lordships come to see the evidence of Lord Kelvin you will come to the conclusion that their case is, and the statement in the specification is that the mercury is practically—I do not say absolutely—in their fig. 1, stationary, in so far as the particles of mercury have reference to each other.

Lord Justice Rigby: I understand that you have not used your patent?

Mr. Terrell: We have erected enormous plant, but the working of the patent is in suspension during the present proceedings. We have done enough to prove a commercial value to the thing, and then we stopped until our rights have been decided in the Courts.

Counsel then read the evidence given in the Court below.

The further hearing was adjourned.

The hearing was resumed on Wednesday, when Mr. Terrell proceeded with the reading of evidence given in the Court below as to the various patents.

Referring to the testimony of Mr. Swinburne, the Master of the Rolls said he understood from him that the action of the ribs would be to stop the rotary motion of the mercury and drive it inwards. The defendants were, he believed, at issue with Mr. Swinburne there.

Mr. Terrell said in one sense, but they were not at issue in another sense.

The Master of the Rolls: You want to make out that the mercury moves, but you say it does not matter which way?

Mr. Terrell: Yes, that it must move in order to get from one place to another seems obvious.

Lord Justice Rigby: That is part of your case, and an important one.

Mr. Terrell: Yes, and Mr. Swinburne says there is a stirring and a movement, and if there is a stirring there must be movement. Whether produced by centrifugal action driving the mercury outwards, or whether it was produced by the mercury re-attaining its level after being driven inwards did not matter. The whole object of the apparatus was to change the position of the mercury.

The Master of the Rolls: I think I understand your point. You say you don't do what Kellner does, that is, move your bells over the mercury, but you say you move your mercury.

Mr. Terrell: Yes, we have got a rib which stops the mercury rotating, and it doesn't matter much which way it goes when it stops rotating, but that it travels one way or the other there can be no doubt.

Lord Justice Williams: Whether you take Kellner's or Rhodin's system it is not really true to say that there is no motion of the mercury whatsoever!

Mr. Terrell: I agree. We say there must be a motion of the mercury, but we say Kellner places his mercury under each bell by the movement of the bells, and we change the mercury by the movement of the mercury.

The Master of the Rolls: Yes, but you move your bells as well.

Mr. Terrell: We move our bells to make the mercury move.

Lord Justice Rigby: There must be outward movement of the mercury at one part of the circle, and apparently an inward motion at another part.

Mr. Terrell: Yes, it must be, or else the mercury would pile up somewhere.

Counsel, continuing, remarked that the evidence showed that all that was required to make Castner do exactly what Kellner did was to make Castner's paddles work faster.

Lord Justice Williams did not think that Mr. Terrell's questions to the witness, and Mr. Swinburne's answers, dealt with identically the same matter, which was apt to lead to confusion.

Mr. Terrell: I was dealing with the motion of mercury with regard to the cells. The witness, perhaps, had in his mind the difference in the motion of the mercury with regard to its containing cell. There probably is a difference, but the whole point is the tranference of the mercury from one cell to another. The plaintiffs say "we get an advantage, and the advantage that we get over Castner is an economy of mercury." But I may point out that there is no removing of the mercury over Castner, because we have only got to move Castner's paddles a little faster and we get rid of the whole point of the economy of mercury. On the plaintiff's own showing, if the paddles were moved a little faster, the whole advantage is gone. Kellner puts less depth of mercury in a vessel, in respect of which it is intended to remain stationary. He moves his bells over that and partly dips into it, and it is obvious that in doing that there must be some motion of the mercury. Castner, instead of moving his bells, utilises paddles, the only difference being that Kellner moves his mercury at a depth of $\frac{1}{8}$th of an inch, and Castner a little lower, the whole object of both being to move the mercury in relation to the bells. There is nothing *qua* the manufacture of soda in that.

During the reading of the evidence, the Master of the Rolls asked Mr. Terrell if, when the sodium was amalgamated in the mercury, there was a local action.

Mr. Terrell: It fuses all through. In stirring you assist the diffusion, but if you have a perfectly still body of mercury, and you put a little body of sodium into that, you get amalgamation and thickening on the top. It remains there for a time, but after a minute or two it is gone, and is diffused through the whole body of mercury. To illustrate this process. If you take two fluids—spirit and water—you put the spirit at the bottom of the glass, and then you put in the water. If you hold up the glass to the light you see the spirit at the bottom, but without any stirring you will see the spirit going over the whole water. That is the whole process of diffusion. Sodium is extremely light, probably the lightest of all chemicals, and mercury the heaviest, and yet there is diffusion.

In answer to Lord Justice Vaughan Williams, the learned counsel said that if mercury were put in a vessel and then salt were put in it immediately began to charge sodium. So long as it was there it loaded up. If you changed it and put in water when there was no salt, then there was unloading to a point, so that you had the mercury getting richer when charging to ·2 and then getting poorer to ·1.

Lord Justice Rigby: How much space does a pound of mercury occupy?

Mr. Terrell: A very small space indeed.

Mr. Astbury: Mercury is 14 times as heavy as water.

Mr. Terrell said that the small bottle then in Court for use in experiments to show their Lordship contained 75 lbs. of mercury.

Mr. Terrell asked their Lordships if they would like to see Rhodin's machine work.

The Master of the Rolls said that they would, and upon the model being charged with mercury, their Lordships came down into the body of the Court and saw it at work.

Mr. Terrell then continued reading the levidence given in the Court below.

Lord Justice Vaughan Williams: Is mercury a difficult thing to mix?

Mr. Terrell: No.

Lord Justice Vaughan Williams: More difficult than water. If you have got a glass of water and you introduce a spoon or glass vessel into the glass of water, you will mix together the particles of which the water consists considerably. If you were to put the same spoon, or the same glass into the glass of mercury, although you could displace the particles the moment you withdrew your spoon, to a larger extent the particles would go back to the same place as they had been displaced from.

Mr. Terrell: I can quite understand your Lordship thinking that, but quite the opposite takes place. Mercury was exceedingly mobile. Mercury was much easier to mix than water.

The hearing was again adjourned.

White *v.* General Electric Company.

In the Westminster County Court on Thursday, February 23rd, Mr. Harry White, a theatrical armourer, of Bow Street, brought an action against the General Electric Company, Limited, to recover £17, the price of an armature. The case was tried by his Honour, Judge Lumley Smith, Q.C., and a jury. The facts were very simple. In 1895 plaintiff bought a Newton dynamo of the defendant company for £33. It was not called upon to do much work, but in December last the armature broke, and he had had to buy another to replace it. His contention was that there was a flaw in the spindle to cause it to break. On the other hand, it was pointed out that it worked for several years, and a large body of expert evidence was called to show it was properly made, and that there were many things which might have caused the accident—want of oil, overloading, sudden reversal, and so on. The jury found a verdict for the defendants, and judgment was given accordingly, with costs.

Lammer *v.* Clemenci.

At the Westminster County Court this week, before Judge Lumley Smith, Q.C., plaintiff, an electrician, claimed for an electrical table which he had supplied to defendant for a bear to dance upon at the Royal Aquarium at £3 6s. 4d. The defendant said that the shock was not strong enough to make the bear dance, but after hearing the details judgment was given for plaintiff for two guineas, with costs.

THE NERNST ELECTRIC LIGHT, LIMITED.

Our article of a fortnight ago upon the Nernst lamp, in which we gave a brief *résumé* of the opinions of the directors of the Allgemeine Elektricitäts Gesellschaft, of Berlin, upon the prospects of this new invention, has led to a letter from Mr. Swinburne in the columns of the *Pall Mall Gazette*,* calling in question the accuracy of our extracts from the German report. On account of the importance of the interests at stake, and in order to prove that the *inaccuracy* is not on our side, we give below the original German of the extract upon which we based our remarks:—

"Auf eine Anfrage über die Nernst'sche Glühlampe wurde erwidert, dass die Versuche, die mit derselben seitens der Gesellschaft gemacht seien, zu einem befriedigenden Resultat geführt hätten, so dass die Gesellschaft mit derselben demnächst an den Markt kommen werde.

* *Pall Mall Gazette*, February 27th.

"*Trotz des einfachen Aussehens sei die Lampe sehr komplicirt*, und bedürfe zum Anzünden eines Vorwärmers, sie sei auch heisser als die Glühlampe, die den Vorzug der sofortigen Selbstentzundung habe, und biete ausserdem nicht die absolute Feuersicherheit wie jene. *Diesen Nachtheilen* ständen aber grössere Oekonomie und stärkere Leuchkraft gegenuber."—*Elektrotechnische Zeitschrift*, December 15th, 1898, p. 848.

The *Pall Mall* City editor in a short paragraph upon the prospectus of the Nernst Electric Light, Limited, expressed his surprise with regard to the discrepancy between the English and German opinions upon the prospects of the lamp. The obvious explanation is, of course, that in the one case it is the *vendors*, in the other case *the purchasers*, who are discussing the merits of the invention; and as is usual in company promotions, their views are not very harmonious. In this connection it is interesting to recall the fact that a similar difference of opinion manifested itself in the early history of the glow lamp, and that Mr. J. S. Forbes, when addressing the third annual meeting of the shareholders of the Swan United Electric Light Company, stated that:—

"On the other side (of the capital account) there were patent rights, £104,000—awfully in excess of what ought to have been paid, but there it was. "It was very easy to be wise after these periodical manias which seized the public, when they were induced to give a great deal more for patents than the patents turned out to be worth."*

If the £104,000 had been £270,000, Mr. J. S. Forbes' remarks would doubtless have been unfit for reproduction in the columns of a respectable journal like our own.

The surprise of the *Pall Mall* City editor, who must have memories, some of them painful, of hundreds of such discrepancies between promoters' hopes and sober facts is therefore amusing. We hope Mr. Swinburne's nice little talk upon the simplicity of the lamp (even a steam engine is simple if you confine yourself to a description suitable to infant minds of its essential parts), and the version which he supplies of the Allgemeine report, restored the City editor's peace of mind.

We are afraid, however, that shareholders will be doubtful of their wisdom in investing capital in the Nernst Electric Light, Limited, in spite of Mr. Swinburne's statement that the German report "is anything but pessimistic." One does not expect "the greatest invention in electric lighting since the infancy of the industry" to be damned with such faint praise, by a company which owns the German patent rights, and possesses the option of purchasing those for most of the other European countries.

With reference to the question of capitalisation, we may state that we support the *Pall Mall* City editor in thinking that £270,000 is an exorbitant sum to ask for the patent rights covered by the terms of the purchase. In our note of last week, written before the prospectus was published, we stated that we understood the new company was to obtain possession of the English rights in addition to those for certain colonies and dependencies of the Empire. Even if this had been the case, we should have regarded the sum asked as excessive. But the Allgemeine Company, of Berlin, possesses the option for the English rights; and the £270,000 is being paid for rights in countries, some of which are undeveloped, and in which there can be no large demand for lamps of any kind until the life of the patents has been considerably shortened.

We have strong grounds for believing that the infinitely more valuable European rights have been purchased by the Allgemeine Company, of Berlin, for a sum which is a mere fraction of the above, and as stated in their last report, the sum paid for the German patents has already been written off their capital account.

The over-capitalisation which has occurred in the flotation of this new company will, in our opinion, greatly handicap its healthy development, and we should recommend our readers to hold aloof from its shares until there are some better proofs of its ultimate success.

If the promoters, directors, and consulting engineer of the Nernst Electric Light, Limited, are as sanguine of success as their prospectus would lead us to suppose, we hope they will give practical exhibition of it, by holding the whole of their shares for five years. If at the end of that period they can dispose of them at par, we shall be considerably surprised, and we will tender to them our congratulations.

* Electrical Review, March 26th, 1886.

ELECTRIC LIGHTING FOR HACKNEY.

Hackney has waited long for electric lighting. Islington, St. Pancras, Shoreditch, Hampstead, and other contiguous districts are to-day in the enjoyment of advantages of which Hackney knows nothing. The captious twaddle of the agitating Vestryman, who must oppose everything, and the company promoter, have been important factors in the progress which Hackney has *not* made. But last year when the matter was laid before the ratepayers and electors to decide whether they would or would not have a municipal plant, the reactionary party, which had kept matters back too long already, suffered a crushing defeat, and the party pledged to adopt a municipal electrical scheme came into power with an overwhelming majority. One of the first steps undertaken by the new Vestry was the appointment of a consulting electrical engineer to prepare a scheme. Several names were suggested, and rather too hurriedly for some members, the selection fell upon Mr. Robert Hammond. The district under the control of the Hackney Vestry is a very widespread one and covers about 3,299 acres, therefore to supply any fair proportion of it with electricity must necessarily require a very large scheme. Hence it comes about that the outlay recommended by Mr. Robert Hammond in his most exhaustive and detailed report to the Electric Lighting Committee totals up to the respectable figure of £247,367, this expenditure to be spread over a period of four years. The scheme is a very ambitious one, and a profit is anticipated upon the second year's working. Mr. Hammond draws attention to a direction in which Hackney profits somewhat by waiting. The policy of putting down a very small installation for supplying two or three thoroughfares at the initial stage, and extending buildings, plant, and mains by dribbles and drabbles just as occasion requires is not recommended. Other London "undertakers" have done this, and now perhaps regret it. Therefore Hackney was advised by Mr. Hammond to "go the whole hog," and spend a quarter of a million.

The compulsory area covers High Street, Kingsland; High Street, Stoke Newington; Kingsland Road (part), Mare Street, Stoke Newington Road and Dalston Lane, but the proposal is to lay distributing mains (about 110 miles) in a great number of minor thoroughfares, these streets being fed from about 17 distributing boxes placed at different points. The three-wire system, with 500 volts on the outer conductors, is recommended, consumers to be supplied at 250 volts. The cost of distributing cables, including the laying thereof in all the roads specified, is £108,354, but it is advised that they be laid for the compulsory area at a cost of £7,862, the expenditure for the first four years upon roads outside the compulsory area being £50,000, in addition to which there will be the feeder cables (31,750 yards) and boxes, costing £38,354. Mr. Hammond advised that plant capable of supplying 75,000 8-C P. lamps be put down in the first instance. For public lighting, 250 arc lamps are suggested in place of 292 gas lamps, each lamp-post to be fitted with two 32-C.P. incandescents for use after midnight. Incandescent lamps are suggested for gradual adoption in all the minor thoroughfares, two 16-C.P. incandescents, enclosed in a lens reflector globe, and lantern, to take the place of the ordinary gas lamp. The estimated outlay upon the public lighting is, for arc lamps and cables, &c., £16,487, and for incandescent lighting, £4,513.

The position of site has yet to be determined, but the Vestry is advised to secure one large enough to allow of easy extensions. If the site is central, the continuous current system will be adopted. At first two 1,000-H.P. direct driven generating sets, and two 500-H.P. sets would be installed. The boiler equipment (six boilers, steam feed pumps, electrically driven pumps, economiser, superheaters, &c.) would be £5,700; pipes and valves, £2,500. The cost of the engine house plant, specified in the report, would be about £30,000, water coolers, &c., £2,000, this making the total outlay for generating plant for 50,000 8-C.P. lamps burning at one time (or 75,000 on consumers' premises), £40,200. Buildings would cost £21,000; connections to consumers' premises, meters, &c., figure at £24,000; sundry expenses, fees, &c., work out at £12,220; contingencies, £10,731. The figures thus total out at £225,367. Tables are given for the interest of the vestryman to show him what revenue such an installation would earn at 5d. per unit for lighting and 2½d. for power, and 3½d. for public lighting.

The remaining £22,000 is for the cost of establishing a refuse destructor plant. For 1897 the cost of collecting and disposing of 50,738 loads of refuse was £15,195 7s. 1d., or 5s. 11·87d. per load, or 8s. per ton. Sixteen cells are recommended. The report goes at considerable length into the questions of heat given off in burning, utilisation and storage of the heat, and arrives at the conclusion that by adopting the refuse destructor there will be a total credit to the destructor on account of steam supplied to the electricity department of £3,515, but from this £750 has to be deducted for value of electricity supplied to the destructor for lighting and motor purposes, making the net credit to destructor £2,765, representing 1s. 5½d per ton on the 38,000 tons. The annual consumption of coal in the destructor is put at 753 tons, costing £753, or equivalent to 4½d. per ton of refuse cremated. The net result of the destructor scheme is a cost of 5s. 10d. for cremating the refuse against the present cost of 8s. per ton, being an estimated saving of 2s. 2d. per ton, or £4,116 per annum with all the advantages of the better method of disposal. But for the adoption of the combined scheme the boiler house plant would cost £5,000 additional capital expenditure.

Mr. Hammond also brought forward an alternative proposal for the supply either by a combined scheme or otherwise for the compulsory area only, but the Committee advised the adoption of the combined scheme for the enlarged area, and they recommended that this be approved by the Vestry, that it be referred back to Committee with power to consider as to sites, and that Mr. Hammond be engaged to carry the scheme into effect.

The Vestry held a special meeting on Wednesday evening to discuss the report and recommendations. The scheme was adopted by a large majority. Mr. Hammond was in attendance, and for about an hour was subjected to cross-examination, the questions put to him being so ably and lucidly answered that vestrymen must have known the ins and outs of the question far better than they would have done had they been allowed, as they desired, to debate the scheme among themselves for half-a-dozen sittings. It is hardly within our province to criticise the moods and fancies of opponents who think they know as much or more than an electrical expert. Were it within our scope, we should be inclined to say something more than usually strong about the systematic obstruction of the opposition (moderate) party, who, after the scheme had been passed by a large majority, used every conceivable tactic to prevent the committee from being empowered to look for sites. At past midnight the Vestry was in the throes of a series of senseless divisions on the point, one party trying to tire the other out. Subsequently, we understand, the motion was carried, as was also Mr. Hammond's appointment as engineer.

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—On 24th ult., Thomas Ford, chandelier and electrical fittings manufacturer, appeared before Mr. Registrar Parry at the Birmingham County Court, and his public examination was closed.

Liquidation Notices.—A meeting of the City of Bath Electric Lighting and Engineering Company will be held at 2, Northumberland Buildings, Bath, on Wednesday, March 29th, to hear the account of the winding up operations from the liquidators (Messrs. C. J. Wharton, B. H. Van Tromp, and W. Jeffery).

A meeting of the B C. Electric Syndicate will be held at 1 and 2, Great Winchester Street, E.C., on April 11th, to consider the account of the liquidator (Mr. A. E. Maidlow Davis).

Creditors of the Standard Dynamo and Motor Manufacturing Company must send their names and the usual particulars to the liquidator, Mr. Wm. Beanland, 35, Hustlergate, Bradford, by March 15th.

Meeting of Creditors.—A meeting of creditors was convened for yesterday by Messrs. W. H. Steward & Son, solicitors, Leeds, in regard to the affairs of Mr. J. A. Edmondson, Globe Electrical Works, Kirkstall Road, Leeds. A statement of affairs was to be submitted.

British Insulated Wire Company.—It is stated that this company, which quite recently completed large extensions to the works at Prescot, has decided upon further enlarging the premises, thereby nearly doubling their capacity. Plans have been approved and foundations got out.

Buckingham Palace.—The daily press says that the electricians of the Office of Works are just now busily occupied in illuminating Buckingham Palace. Hitherto electricity has been used in the Palace to a very small extent, but before the ensuing "season" is in full swing the whole of the edifice will be lighted.

Bury St. Edmunds Boilers.—The successful tenderer for the boilers for the Bury St. Edmunds Council was stated last week as Davey & Co. This should be Davy Bros., Ltd., of Sheffield.

Change of Address.—Mr. Sydney Morse is moving to more commodious offices at 37, Norfolk Street, Strand, W.C.

Direct Reading Ohmmeter.—Messrs. Smith, Simpson and Co., Limited, of Deansgate, Manchester, have been appointed sole European agents for the direct reading ohmmeter, which was illustrated and described in the Electrical Review for December 23rd, 1898, p. 923.

Electric Launches.—The "Vril" launch that was exhibited at the Aquarium last month, having proved of some interest, it has been decided to keep it on show at Stand No. 23 during the month of March.

Electric Lighting Provisional Orders (Clauses).—In the House of Commons on 27th ult., Mr. Ritchie, in asking leave to introduce a Bill for incorporating in one Act certain provisions usually contained in provisional orders under the Electric Lighting Acts, 1882 and 1888, said that hon. members who were familiar with provisional orders under the Electric Lighting Acts were aware that 70 or 80 clauses were incorporated in the Bill, those clauses being almost identical with every one of the electric lighting orders made. This practice entailed great expense and delay in connection with the orders, and it also created a considerable liability to mistakes. The present Bill provided, that instead of setting out in every electric lighting order, as was now done, the 70 or 80 clauses, these might be incorporated as was the practice now with regard to clauses of the Acts. They would not be stereotyped, but the Board of Trade would have the power to vary them if necessary in respect of any particular order.

Extension of Premises.—Owing to the large demand for high voltage and other specialities, and pending the construction of some new works in Islington, Mr. A. P. Lundberg has taken additional premises in Culford Road, Balls Pond, N., for prompt execution of orders in hand.

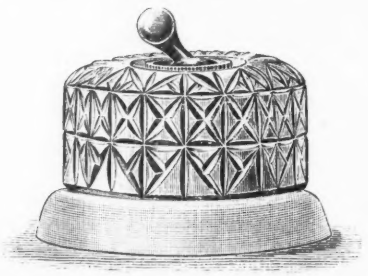
Fire.—On Monday evening a fire occurred at the office of the Spanish National Submarine Telegraph Company in Cannon Street, E.C.

General Power Distributing Company's Bill.—A statement is being circulated, signed by the Lord Mayor of Sheffield, and the Mayors of Nottingham, Lincoln, Derby, Chesterfield, Rotherham, Doncaster, Mansfield, and Ilkeston, of the position of those municipalities with regard to the above Bill, which is about to come before the House of Commons for the second reading. The signatories state, says the *Times*, that although the Bill gives to the company power to erect a generating station at Sookholme, Notts, and thence to supply electricity over every part of an area of over 2,000 square miles, there is no obligation on the part of the company to erect this station, but they may purchase lands in any part of their proposed district for this purpose. The only obligation upon the company to spend any money on their scheme is that they must spend £50,000 within five years, which insignificant sum, it is observed, has to be spent on the undertaking—that is to say, if they spend this amount in any part of their area they will have the right to keep every other part of the area at their mercy as to the time when, if ever, they will exercise their powers. Thus, if the sum of £50,000 were spent upon supplying Sheffield with electricity, they could hold their powers in reserve for an indefinite period of time with respect to any other borough—*e.g.*, Nottingham. Most of the boroughs have already expended large sums in establishing electrical works. The town councils can supply electricity at charges lower in some cases than those proposed to be the *maximum* charges of the company. The councils cannot make more than 5 per cent. profit, while up to that percentage the profit may be expended in the reduction of the rates or otherwise for the good of the municipality, but the company can make a dividend of 10 per cent., and under a sliding scale can increase this dividend to a large extent. The town councils contend that, as they are able and willing to supply, and are actually in most instances supplying electricity within their districts, the company should not be allowed to come in and compete with them unless it can be shown that the town councils are failing in their duties, to prove which no attempt has been made.

Guildhall Charge.—At Guildhall on Monday, before Mr. Alderman Truscott, Claude Theodore James Vautin, 43, described on the charge sheet as an analytical chemist, late of Upper Hamilton Terrace West, St. John's Wood, and recently carrying on business in Old Broad Street, was charged on warrants with obtaining by false pretences certain valuable securities, share certificates, &c. The prisoner was further charged, under the Bankruptcy Act, with having, within four months previous to the presentation of a petition in bankruptcy, quitted England, taking with him property to the extent of upwards of £20, with intent to defraud his creditors. Detective-inspector Pentin deposed that the prisoner was handed over to his custody at Naples by the Italian police on February 15th. The magistrate adjourned the case and said he could not grant bail.

"James" Alternate Current Enclosed Arc Lamps.—Messrs. J. & A. Anderson, Glasgow, who are Scotch agents for the "James" arc lamp, inform us that they have their enclosed type running successfully, two in series, on an alternating current of 40 cycles. So far as we know this has not been done before.

Luminous Switch.—Messrs. Donnison, Barber & Co., of Manchester, send us a sample of a new tumbler switch they are putting on the market. The switch itself is on the usual lines, but the cover, which is of moulded glass of neat design, is coated internally with a luminous composition which retains the day light or artificial light falling upon it, and gives out in the dark a phosphorescent glow, making the position of the switch in a darkened room quite apparent. There should be a large demand for this article, either for hotel or domestic use. Almost everyone has experienced the difficulty of locating the switch in a strange room. With the "Luminous" switch the difficulty disappears, and one is drawn to it (adverse circumstances excepted) like the needle to the pole.



Municipal Trading.—The Society of Arts is memorialising the Home Secretary, asking him to advise Her Majesty to appoint a Royal Commission to consider the whole subject of municipal trading, and to lay down the principles and limitations on which Parliamentary powers should be granted to municipal and local authorities. They further venture to submit that until such Royal Commission has investigated the subject and reported thereon,

no further powers for trading purposes ought to be granted to such bodies. The Liberty and Property Defence League is also petitioning both Houses of Parliament on the same question. The petition, which is being largely signed by railway, tramway, gas, engineering and electric lighting companies, chambers of commerce, &c., throughout the kingdom says that it is desirable, before the numerous local Bills with trading clauses are sanctioned by the Legislature, that a Committee of both Houses, or a Royal or other Commission, be appointed to define the extent to which municipal trading should be sanctioned by Parliament; and that meantime all provisons in local Bills for the extension of municipal trading should be suspended until such Committee or Commission has reported thereon.

The Newport (Mon.) Chamber of Commerce has decided to let lie upon the table the letters received from the London Chamber of Commerce and the Liberty and Property Defence League with reference to the above subject.

Rejection of Electric Power Supply Bills.—Three measures for the supply of electric power came before the Standing Orders Committee of the House of Commons on Tuesday. One of these, the Lancashire Electric Power Bill, proposed to provide electrical generating stations and the erection of buildings and works for the production, storage, and distribution of electricity within a large area in Lancashire. It was proposed, says the *Times*, that the energy might be distributed by the company, or might be supplied by them wholesale to any local authority, company, or person within the area of supply, though only by means of some system which should be approved in writing by the Board of Trade, and subject to the Board of Trade regulations. The second measure, the title of which is the South Lancashire and Cheshire Electricity Company Bill, was similar in purpose; and the third was for incorporating and conferring powers on the Leicestershire and Warwickshire Electric Supply Company, and also, as may be gathered from its title, dealt with an extensive area. The cases came before the examiner of private Bills at the usual time early in the Session. He held that the *Gazette* and other notices did not define the parts of the counties to be supplied with electrical energy, but referred the description thereof to a map to be subsequently deposited with the respective clerks of the peace. Nor were certain boroughs and urban districts proposed to be supplied named in the notices. Substantially the same point was raised in the case of each of the three measures, and non-compliance with the standing orders of Parliament was reported by the examiner in each case. This decision was affirmed on Tuesday by the Standing Orders Committee, which is presided over by Mr. Halsey. The committee, after deliberating for some time in private, informed the parties interested, who were in waiting, that they had decided that the standing orders could not be dispensed with. The effect of this decision is that the Bills are dead so far as the present Session is concerned.

Rubber.—The question of maintaining the present high output of rubber or caoutchouc in the Congo State is, says the *Standard* Brussels correspondent, of the first importance in regard to its material condition. An important order has just been signed by King Leopold with this object. A certain number of trees or caoutchouc-bearing lianas are to be planted each year in all the forests of the Domain. A new forestry staff of one inspector, six controllers, and six sub-controllers is to be organised for the purpose of seeing that the new order is fully enforced.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Last week the Gas and Electric Lighting Committee passed the electric lighting accounts for 1898, and it was agreed that the price of the current should remain the same as at present at least for six months, when the matter will again be considered. Authority was given to obtain extra copper strips for the mains. On a report from the engineer, it was agreed to purchase boilers and an engine for the electric lighting station at a total cost of £7,500.

Aberdovey and Towyn.—The Aberdovey and District Council has been informed that Mr. C. Corbett would be pleased to meet the Council and discuss the electric lighting scheme with them. As far as he could see, and if the scheme proved as satisfactory as appeared from Mr. Ruck's report, there would be no difficulty in getting a company to take it up.

Ballarat.—A Melbourne paper says that an electric lighting order has been granted by the Governor-in-Council to the Ballarat Electric Supply Company, Limited, in respect of the whole of the municipal districts of the city of Ballarat, town of Ballarat East, and borough of Sebastopol.

Bangor.—Mr. Ainger, the lessee of the Port Penrhyn writing slate manufactory, has had an installation put in by Messrs. Lindsay & Browning, who have just started business as electrical and consulting engineers.

Barnstaple.—The Town Council is taking steps to obtain a provisional order.

Battersea.—Last week the Vestry resolved to serve a notice upon the County of London and Brush Provincial Electric Lighting Company, requiring the company within 24 hours to take up and remove the mains laid in Trinity Road, and to reinstate the pavement, and put it into its former state. This notice, which is based upon Section 109 of the Metropolis Management Act, 1855, is the result of the fine recently inflicted upon the company for breaking open Trinity Road without giving notice to the Vestry as required by the same section of that Act. It was decided to retain a junior counsel to appear on behalf of the Vestry against the company's Bill.

Belfast.—The Electric Committee has considered tenders for the supply of incandescent electric light fittings for street lamps, and that of the Reason Manufacturing Company has been accepted. The engineer submitted the correspondence he had had with the Board of Trade regarding the recent explosions in the neighbourhood of Ann Street. There will probably be a Board of Trade inquiry as to the cause of the explosion.

Birmingham.—The Estates Committee recommend the Council to approve of a scheme for lighting the municipal buildings by electricity.

Bristol.—The Electric Light Committee has resolved to extend the mains immediately in Apsley Road, St. John's Road, Clifton, and St. James's, Barton. The private lighting business increases; during the past few weeks the number of lamps has increased from 66,450 to 67,144. Mr. Faraday Proctor has submitted his report upon the best mode of extending the electricity works, which must, it seems, be immediately proceeded with. The Committee will give special consideration to the report at its next meeting.

Buxton.—A Local Government Board inquiry *re* the proposed £25,000 electric lighting loan was held on 24th ult. Prof. Kennedy was present, and said that the system (6,000 8-C.P. lamps) would be a three-wire one, current being distributed by means of trunk mains to the centre of the town and there feeding a network of distributing mains. The Council wanted to borrow for repayment over 50 years, but the inspector said that 25 years was the maximum for electric lighting loans.

Canterbury.—Petitions from ratepayers in various parts of the city have been received by the Town Council asking that the plant be extended, and it has been decided "That the specification submitted for the proposed extension be approved, and that tenders be invited for the works subject to the consent of the Local Government Board." There has been considerable delay in the completion of the dust destructor, and notice has been given, in accordance with the terms of the contract, to Messrs. Beaman and Deas that it is the intention of the Council to enforce the penalty clause owing to its non-completion.

Canterbury.—The Corporation electricity works will be opened on March 10th. Current is at present supplied from 5 to 11 p.m., but on April 1st a 24 hours' service will be introduced. The public is being notified as to charges and discounts, &c., by local advertisement.

Chelmsford.—A communication received from the Board of Trade with reference to the question of overhead wires has been referred to the committee appointed to consider the proposed purchase of the electric lighting undertaking.

Chorley.—In reply to a communication from the Town Council *re* the large power schemes, Lord Balcarres, M.P., has replied that he feels the question of the electrical development to be one which will have so great an influence upon the future commercial and industrial development of this country, that it would seem to him wrong to vote against the second reading of the Bills in question. He is prepared to vote against the third reading of the Lancashire Electric Power Bill, but to vote against the second reading of this measure would prevent the discussion which this difficult matter demands from a Private Bill Committee.

Doncaster.—At a Local Government Board inquiry held on 21st ult. with respect to a proposed £30,000 loan for electric lighting, it was shown that the estimated cost as submitted by the consulting electrical engineer, Mr. Shoolbred, was:—Generating plant, £15,000; buildings, £5,000; street mains, distributing cables, &c, £10,000. The site selected for works is in Bath Fields, Corporation property. The plant would be available for both lighting and traction. The Corporation wanted the loan spread over 45 years, but the inspector did not think anything like that period would be sanctioned.

The Corporation has approved of the plans of buildings for the electric lighting station submitted by the borough surveyor.

Dublin.—On Wednesday a Local Government Board inquiry was held *re* the Corporation's proposed loan of £7,000 for electric lighting purposes and other sums for other purposes.

Edinburgh.—The burgh engineer has recommended the formation of a subway from the M'Donald Road electric lighting station along M'Donald Road and southwards up Leith Walk as far as Picardy Place. Bailie Mackenzie said the subway was meant to contain the enormous amount of copper that was required to go there when the station at M'Donald Road was complete and to avoid interfering with the streets afterwards. He thought himself that the cost would be from £8,000 to £10,000. If they did not go on with a subway they would have large culverts to make on the south side of Princes Street, costing probably between £5,000 and £6,000. The matter was recommitted.

The Council has, on the recommendation of the Electric Lighting Committee, accepted the following tenders: Iron and steel, Messrs. Redpath, Brown & Co., £7,788; steel work and roofs, Arrol's Bridge Company, £2,823. Bailie Mackenzie said these were not the lowest estimates, but they had been adopted in view of all the circumstances and the extraordinary pressure of work.

Farnborough.—The Council on Friday last, after going into clauses in the agreement, decided, by 6 votes to 4, to transfer the provisional order to Power & Traction, Limited.

Gillingham.—Mr. Jasper having been asked at what price he would be willing to sell his electric light undertaking to the District Council, has replied that he is considering the matter.

Glasgow.—With a view to keeping down the cost of street electric lighting and thereby securing its more rapid extension, the Watching and Lighting Committee of the Corporation are considering the proposal to adopt the Edinburgh plan of extinguishing every second lamp at midnight.

Grantown.—The ratepayers have appointed a deputation to wait upon Lady Seafield at Cullen House in order to secure approval to the scheme for utilising the water-power of the Spey for electric lighting purposes.

Greece.—La Société Electrique de la Mediterranée (Thomson-Houston) is establishing a small central station at Syra. The company has also undertaken the electric lighting of the town of Kalamata.

Hampstead.—The Lighting Committee has reported that consumers' accounts for the quarter ended Christmas last amounted to £8,312, as compared with £5,892 for the same quarter of 1897 (increase 41 per cent.). The London County Council will advance a loan of £2,560 for the arc lighting of West End Lane, from Quex Road to Mill Lane. The General Purposes Committee is ascertaining what action other local authorities are taking with regard to the Central Electric Supply Company's Bill, which proposes to supply Hampstead and other districts.

Hanley.—The Council has resolved to ask the local members of Parliament to oppose the large electric power schemes. Messrs. R. A. D. MacAlister (Edinburgh) and R. G. Tinscott (Eccles) were appointed, out of 39 applicants, junior assistant engineers at the electricity works at £80 a year each, rising by £10 a year to £100. The salary of Mr. W. Adams, assistant electrical engineer, was increased from £130 to £140 for the next 12 months, with a further increase to £150 for the following year.

Hanwell.—With regard to the offer of the London United Tramway Company to supply the Council with current for electric lighting, the Works Committee is asking the company on what terms it would supply the Council.

Hebden Bridge.—The Birchcliffe new chapel is to be lighted by means of 138 16-C.P. lamps, Mr. R. S. Blackburn having the contract for the necessary work, which includes the supply of a gas engine, dynamo, and accumulators.

Hereford.—The Council is now inviting tenders for the erection of the electricity works buildings.

Hull.—The electrical engineer (Mr. Barnard) has submitted the estimates for the year, showing an expenditure on generation of current of £3,775; on distribution of current, £450; on repairs and maintenance, £1,650; on management expenses, £1,250; total expenditure, £15,570. It was estimated that £15,000 would be realised by the sale of electricity, and £570 from meter rents. The chairman of the Electric Lighting Committee said last week that the Committee had had large demands, for which they had not provided in their borrowing powers. It is stated that 640,000 units were sold last year. The generating power is now 800,000 units.

Ingleton.—The local committee which canvassed the district *re* electric lighting reports the result of the canvass as being far in excess of their expectations. The greater part of the share capital had already been subscribed in Ingleton. It was unanimously decided to apply for registration, and the electric light may be ready by the autumn.

Inverness.—The music hall, which is to be reconstructed, will be lighted electrically, also the shops forming part of the building.

Islington.—The Board of Guardians last week approved of the scheme drawn up by Mr. J. Enright for the erection of an installation to supply 1,700 16-C P. lamps. He recommended the Board to put down an engine of 135 B.H.P., with a storage battery of about 1,000 ampere-hours. Estimate of plant—Engine and dynamo, £1,050; engine and dynamo, £1,050; erecting engines, &c., £130; cables, £200; battery, £650; contingencies, £100; total, £3,180. Yearly Charges—Interest on £3,420 at 2¾ per cent., £94 1s.; depreciation, sinking fund at 3 per cent., £103 12s.; wages, &c., £160; oil, waste, and sundries, £100; total, £456 13s. He calculated that the total cost per unit would be 2d., whereas the Vestry Electricity Committee would charge them 4d. under a two years' agreement.

Kensington.—The Vestry has decided to abandon the application for powers to supply electricity in the parish, and will support by petition the Kensington and Notting Hill Bill, which confers powers upon the Notting Hill Electric Lighting Company, Limited, and the Kensington and Knightsbridge Electric Lighting Company, Limited, to construct the works for lighting the streets of Kensington.

Kingston.—The fifth annual report by the borough electrical engineer shows that the profit on the electricity undertaking for 1897 was £1,221. The net profit, after paying interest, &c., was £119, and the total deficit on the undertaking was £1,112 odd. This is stated to be due to the large payments made during the year under the heads of "payment of interest" and "repayment of capital," so that although the profit on the works had considerably increased, the total deficit upon the undertaking was larger than last year. The result of the year's working showed that interest had been earned upon the capital at the rate of 3 per cent., with a further sum of £119 3s. towards the repayment of capital.—Alderman Collings said that although the figures mentioned did not come up to his anticipations, the Corporation had reason to be thankful for the general results of the year, and to congratulate the electrical engineer upon his endeavours to decrease the items of expenditure.

Kingston-on-Thames.—Messrs. Prestwich & Burt (successors to Messrs. New & Mayne) are to fit up the new Technical Institute for electric lighting.

Kingswood.—The Council is entering into a 10 years' contract with the gas company for street lighting.

Lancaster.—The electrical undertaking is making satisfactory progress. The amount originally estimated was £781 1s. 11d., but the actual profit during the past year has been £1,258 4s. 9d. Of this £200 will be added to the reserve fund, and the balance will be transferred to the borough fund towards the relief of the rates. The income was £3,902 17s. 11d., while the estimated income was £3,350 9s. 9d. The total expenditure during the year was £2,644 13s. 2d., over £100 more than was estimated. During the coming year a considerable sum will be spent on additions to the plant, and the estimated expenditure is £3,717 18s. 1d., but the decrease in the cost of the current to 3d. per unit for motor purposes, and 4½d. per unit for private lighting, will, it is hoped, extend the use of electricity as a luminant, and an income of at least £4,626 is anticipated. Mr. Fraser, the new electrical engineer, hopes it will be considerably more. All the principal thoroughfares and squares are now lighted by electricity.

Lane End.—It is stated that the village shops are to be supplied with electric current from the private installation at Mr. R. Smith's factory.

Lee.—The District Board has appointed Mr. A. Snell consulting electrical engineer for a year, during the execution of work by the Blackheath Electric Lighting Company.

Leeds.—The Lighting Committee has decided to apply for power to borrow £150,000 to extend the electric mains in the city, enlarge the present generating station in Aire Street, and to acquire additional machinery. This sum, it is expected, will be adequate to meet the more pressing requirements for the next couple of years. At present, new mains are being laid down through Hunslet as far as the Great Northern Goods Station, and from these it is expected that the majority of the large workshops in Hunslet will procure electricity for lighting purposes. In which direction the Committee intend to further extend their mains has not yet been settled.

Mr E. Talbot, the electrical engineer to the tramways department, is to prepare an estimate of the cost of lighting Boar Lane from the generating station in Whitehall Road. At present, the lamps in Boar Lane receive their current from the tramway power station at Crown Point, and have to be extinguished when the electric trams cease running.

Liverpool.—The Estates Committee have resolved that the piece of land situate on the south-east side of Lister Drive, and adjoining the property of the London and North-Western Railway Company, containing about 66,000 square yards, be transferred to the Electric Power and Lighting Committee for the purposes of an electric generating station, upon certain conditions.

Llandudno.—Mr. Morton, manager of the electric light works, has reported to the District Council that, up to the present, the heat produced by the destructor has resulted in a saving of 50 per cent. of coke, amounting to £372 7s. 10d., and there was therefore an estimated net gain to the Council from the working of the destructor plant of £67 10s. 4d.

London, E.C.—Last week the Court of Common Council had a discussion with closed doors on the report of the Streets Committee relative to the undermentioned draft electric lighting provisional orders, viz.: City of London (Charing Cross and Strand Electricity Supply Corporation, Limited), the Metropolitan Electric Supply (City), and the City of London, St. Luke, Middlesex, and Holborn. The Committee submitted for approval the draft of a proposed reply to the Board of Trade on the applications made to the Board by the Charing Cross and Strand Electricity Supply Corporation, the Metropolitan Electric Supply Company, and the Smithfield Markets Electric Supply Company with a view to dispensing with the consent of the Corporation to the granting of the orders. The *City Press* says that the discussion, which lasted 1¾ hours, appears to have been concentrated upon the question whether the Corporation was prepared to accept the liabilities of the late Commission of Sewers in respect to its action in regard to the City of London Electric Lighting Company. Mr. C. T. Harris (Langbourn) moved an amendment to the report to the effect that the Board of Trade should be informed that the Corporation, having in view the purchase of the existing supply, was content to deal with the existing company, and with no other. The amendment was ultimately carried by a large majority. The *City Press* goes so far as to say that purchase negotiations have been conducted in a more or less informal way for months past, although up to the present little progress has been made. "Now, however, that the Court have definitely expressed an opinion in regard to purchase, it is not at all unlikely that we shall shortly be informed that a round table conference has been convened. Naturally the whole matter will hinge upon the question of what terms are reasonable."

London.—Last week, at the St. George's (Southwark) Vestry, a report was presented from the Electric Lighting Committee to the effect that the County of London and Brush Provincial Electric Lighting Company recently were laying some mains in Marshalsea Road, contrary to plans submitted to and approved by the Vestry. The surveyor, on discovering the fact, ordered the work to be stopped, and the clerk was directed to obtain an interim injunction preventing the company proceeding with the works. This course was approved by the Vestry.

Lynn.—The Electric Lighting Committee has referred the 110 applications for the post of resident electrical engineer to Prof. Robinson for "sifting."

Maidstone.—Last week the Urban District Council decided by 13 votes to 7 to adopt the scheme of Messrs. Kincaid, Waller & Manville for the establishment of an electric lighting station in Fair Meadow, in combination with a dust destructor.

Marylebone.—Last week a vestryman moved a long resolution with regard to the question of purchasing the undertaking of the Metropolitan Electric Supply Company, so far as it affected the Marylebone district, but there was no seconder, and the resolution accordingly came to nought.

The Works Committee last week resolved to take no action with reference to extending the incandescent system of public lighting in Marylebone Road, pending the result of the Marylebone Electric Lighting Bill.

Melksham.—The Council has given consent to an application to lay electric light cable under certain roads to supply some of the shops and private residences, provided, among other things, that the work is done to the satisfaction of an electrical engineer to be employed by the Council.

Monmouth.—The town clerk has informed the Guardians that the Corporation will shortly be ready to supply current, and has suggested that the workhouse should be electrically lighted. The Guardians have referred the matter to the Visiting Committee.

Newhaven.—The Sanitary and Lighting Committee is now considering the electric lighting question.

Oldham.—The Electric Light Committee have decided to raise the salary of Mr. S. W. Newington, electrical engineer, from £220 to £250 per annum.

Penzance.—The company, whose application for a provisional order is being opposed by the Town Council, is asking the Board of Trade to dispense with the Council's consent. The Council have now authorised the Highways and Lighting Committee to call in an expert to advise them generally and to enable them to report on various matters.

Peterborough.—In excavating for laying the foundations for electricity works, an old drain has been discovered, and instructions have been given for it to be diverted.

Rhyl.—The members of the District Council paid a visit to Llandudno on 23rd ult. to inspect the electric lighting and dust destructor plant.

Rotherhithe.—There is to be a special Vestry meeting to consider whether to apply for a provisional order.

Shoreditch.—The Vestry has increased the salaries of Mr. G. Kemp, chief assistant engineer, and Mr. Roscoe, superintendent of mains, from £3 per week to £180 per annum, and by £10 yearly to £200. A new booster for charging accumulators has been ordered from the Electric Construction Company at £399. Several firms are to be asked to tender for a proposed new switchboard.

Stockton.—Last Friday a Local Government Board inquiry was held in regard to the proposal of the Corporation to alter the site in connection with the proposed new electric lighting station.

Stoke-on-Trent.—The Town Council has appointed a sub-committee to visit various places where there are public electric lighting installations.

West Hartlepool.—The Corporation is now inviting tenders for the erection of the electric light station.

Whiston.—The *London Gazette* contains notice of the particulars of the proposed transfer of the Council's electric lighting order for Eccleston, Knowsley, Rainhill, and Whiston, to the British Insulated Wire Company.

Windsor.—The Electric Lighting Company were recently asked to tender for the whole of the street lighting of the town. The tender of the Gas Company was £1,162 15s. for 11,900 C.P. The Electric Lighting Company offered to erect 228 lights for £1,150 per year, which will be equivalent to 32,200 C.P. The tender of the Electric Company has been unanimously adopted. The company hope to extend their mains throughout the whole of the town in about six months, but the contract allows them nine months to complete the work. The present tender for gas terminates on March 25th. In the meantime Windsor will be lighted with oil lamps.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The Council has approved the proposal to equip the Union Street-Woodside tramways on the trolley system, at a cost of £33,000. Particulars were given in our last issue. It is calculated that in comparison with horse traction there will be a saving of 2d. per car-mile by the use of electricity, as well as a gain of 2d. per car-mile through increased traffic.

Bath.—The Electric Lighting Committee has resolved that electric trams should be municipal, and Mr. Metzger and the chairman are to ascertain from other towns where electric cars are running particulars as to cost, working, &c.

The Surveying Committee has approved the principle of municipal electric tramways, the Mayor protesting.

Blackpool.—We hear that a proposal is before the Corporation to run a tramway to Poulton from Talbot Road, and then on to Thornton, where it will be connected with an existing tramroad to Fleetwood. The promoters have asked the Corporation for support in the promotion of a Bill in Parliament, under the Light Railways Act, but there may be some difficulty, as the Corporation are seeking power in Parliament to extend the present system.

Bradford.—The traffic report issued by Mr. C. J. Spencer, manager of the city tramways, shows that during the middle fortnight in February the receipts amounted to £552 8s., and that the electric cars travelled 11,759 miles, the service thus producing 11·27d. per mile. On the Bolton section the mileage was 3,634, and the receipts £158 14s. 10d., and on the Horton section the mileage was 8,125 and the receipts £393 13s. 2d. 21,643 units of electricity were consumed, at a cost of 1·84d. per mile. Since the system was opened the receipts have amounted to £7,286 3s.—£2,494 16s. 7d. on the Bolton section, and £4,791 on the Horton section—upon journeys covering, in the aggregate, 152,613 miles.

Dublin.—The chairman of the Dublin and Lucan Steam Tramway Company informed the shareholders that the electrical equipment of the line had been kept back by difficulty in procuring a suitable site for power house. That difficulty had been overcome, and by the end of the year the line would be working by electricity. As to the financial results of the change, he was sanguine, among other remarks being a hint that possibly they might be able to increase their receipts by charging a moderate rental for electric lighting along the line. An independent company was applying to the Privy Council for an order to construct a new electric line between Lucan and Leixip. They might be able to work that line and their own as one system.

Dudley and Wolverhampton.—Last Friday the Sedgley District Council assented to the transfer of the Dudley and Wolverhampton tramways from that company to the British Electric Traction Company, also to the alteration of gauge.

Germany.—The new electric tramways in the town of Thorn, which have been equipped by Messrs. Felix Singer & Co., of Berlin, have just been completed and put in operation.

Glasgow.—A conference was held on Tuesday between the sub-committee appointed by the Electricity Committee of the Corporation and the sub-committee appointed by the Tramways Committee, with reference to the question as to which department shall supply the power required for the traction of the electric tramway cars on the routes which have yet to be converted to that system. Councillor Paton, the convener of the Tramways Committee, introduced the subject by stating that his sub-committee were of the opinion that his department should generate the requisite power, and if it was decided that they were to purchase their electricity from the Electricity Committee they would undoubtedly be most unwilling purchasers. Mr. Parshall, the London electrical expert who has been consulted in the matter, made a verbal report. He proposes to recommend that the Tramways Committee should construct a large central electric power station, and put down in it four engines, with an aggregate of 17,500 horse-power, the engines to be of the slow-speed type, running at the rate of 70 revolutions per minute. The electricity would be supplied on the high-tension principle at a voltage of 6,500, and the depôts would be utilised as transformer stations to send out the electricity at the present voltage of 550, which is the Board of Trade maximum. Of the 17,500 horse-power, three-fourths would be effective to drive 575 electric cars. At present there are 385 horse cars and 27 electric cars in use. Further discussion of the subject was adjourned.

Hanley.—Last week the Council consented to the application to the Board of Trade of the British Electric Traction Company for six months' extension of time in which to complete the Potteries Extension Tramways, subject to the company entering into an agreement to have the line and electrical equipment ready for inspection by May 7th, or pay a penalty of £50 a day. The Council has also decided that each authority in the district affected be invited to appoint representatives to attend a conference with respect to the proposed scheme for municipalisation of the local tramways.

Hastings.—At a recent Council meeting it was decided to co-operate with Mr. Murphy, who is financing a tramline to Bexhill and district, under certain conditions. Mr. Murphy has engaged to widen a bridge at Bulverhythe, and to raise the road level; to pay a certain sum per mile per annum as wayleave; to grant the right of purchase at the expiration of 25 years; and so far as his line runs within the boundary, to permit the Corporation to purchase at any

time. Mr. Murphy is also ready to take current from the Corporation at a fixed price, but his terms, says a local paper, are not regarded as good enough.

Hull.—The Tramways Sub-committee is considering the 91 applications for the post of electric tramways manager at £300 per annum. At the Works Committee last week a member said they ought not to rest until the electric trams had been taken down Drypool. The chairman said if they could only make satisfactory arrangements with the Drypool and Marfleet Steam Tramways Company, they would buy that undertaking.

Leeds—Considerable progress has, according to a local paper, been made towards the general establishment of the electric system in Leeds. The single line of rails originally laid down in Harehills Road has now been doubled, and all the necessary poles are erected. The work of putting up the poles on the Headingley and Chapeltown routes will, it is expected, be finished within a week or so. At present pipes are being laid for the feeder wire, as well as the telephone wires. The work is being carried out under the supervision of the Highways Department.

Light Railways.—The Board of Trade have confirmed orders authorising the construction of a light railway from Trowse, Norfolk, to Beccles, Suffolk, and a line in the county of Essex between Barking Town and the Beckton gas works.

Liverpool.—It has been arranged to have a crucial test of the capabilities of the different kinds of cars—the Thomson-Houston, the Hamburg and the American cars. They will be tested in actual practice over the same route for a certain number of days and in such a manner that the amount of current consumed can be registered by meter, and other details noted. The Tramways Committee, in considering the question of the street work, and laying of new lines during the ensuing year, has approved of a report of the city engineer recommending that the work be done by the Corporation workmen under the supervision of himself and his staff.

Moss Side.—On 21st ult. Colonel Sir Francis Marindin inspected, on behalf of the Board of Trade, the tram lines which have been recently laid by the Urban District Council. The whole of the lines were approved and their immediate use sanctioned. The rails are bonded, in order that at the expiration of the lease of the Manchester Carriage and Tramways Company the overhead trolley system of electric traction can be adopted without further disturbance.

Newcastle.—On Monday the Tramways Committee agreed, by 11 votes to 6, to consult Prof. Kennedy with respect to the resolution of the Council, concerning the advisability of adopting some system other than the overhead trolley system of working the tramways in the centre of the town. Several letters were received from electrical companies offering to supply the power necessary for running the trams. It was agreed, however, that the applications should stand over for the present.

Norwich.—It is stated that the rolling stock of the Norwich Electric Tramways Company will consist of 54 cars, several of which have been delivered. They are being made by the Brush Company.

Wolverhampton.—The Tettenhall District Council has withdrawn its opposition to the Wolverhampton Corporation Tramways Bill. The Bilston Council approves the South Staffordshire Light Railways Order and the Wolverhampton Tramways Bill, and will support them subject to certain modifications of the clauses.

TELEGRAPH AND TELEPHONE NOTES.

The American Pacific Cable.—We extract the following from the *Empire*:—"The Americans are still talking about laying their cable across the Pacific, *via* Hawaii and Guam. The latter is an island, lying between Hawaii and the Philippines, and was captured from the Spanish early in the contest, probably with an eye to ulterior utility. The cable may be laid by a private company, the Government contracting to pay £20,000 for the transmission of official telegrams from San Francisco to Honolulu, Japan, and China. The company is being promoted by Mr. Schrymser, president of the Central and South American Cable Company. I fancy that he is also being backed by the Eastern Telegraph clique, who hope to delay the British Pacific cable by joining the Yankees. A patriotic scheme! However, the cable must be made in England, laid by British ships, and worked by British operators. The Americans have no facilities for performing any part of the work. An Australian correspondent assures me that the New South Wales people are extremely anxious to have the Pacific cable built, and will contribute their share, £50,000. But the Postmaster-General of that Colony, however, does not think the cable will be built. He seems to think that Canada is hanging back, and Great Britain is not enthusiastic over the project. A decisive answer is wanted from the British Government, but none is forthcoming. Australia is prepared to stand three-ninths of the cost of the cable, if Canada will pay two-ninths, and Great Britain the remainder. It is thought in Australia that Great Britain is desirous of constructing a Cape route, and allowing the United States to build the trans-Pacific cable."

The City Police and the Telephone.—The *City Press* says that after mature consideration the Corporation have decided to place the City police-stations on the telephone. The powers that be have resolved to introduce the telephone system as an experiment, and the seven stations within the one square mile are to be connected forthwith.

Edinburgh Telephone Wires.—In Edinburgh Sheriff Court on 23rd ult., Sheriff Rutherfurd gave judgment on the application on behalf of the Postmaster-General for the consent of the Corporation of Edinburgh to the placing of underground telegraph wires under certain streets. Among the grounds on which the Corporation objected were that the wires were not required for the purposes of the Postmaster-General's Department, but were intended for the use of his licensee, the National Telephone Company; and that by the provisions of the Edinburgh Municipal and Police Act, 1879, the streets and roads under which it was proposed to lay those wires could not be opened up without the consent of the Corporation. The Sheriff, in giving his decision, said it was true that under the Telegraph Act, 1892, the Corporation as road authority had a right to veto the exercise of any powers under the Telegraph Act by a licensee of the Postmaster-General, but in the case of the London Corporation it was held, nevertheless, that the Corporation were not entitled to shackle their consent to works which the Postmaster-General proposed to execute with the condition that the wires should not be used by his licensee, the National Telephone Company. He saw no reason to differ from the conclusion arrived at in that case, first by Mr. Commissioner Kerr, and afterwards by the Railway Commissioners. He thought the objections which they were entitled to raise must be objections of a kind which concerned them as a road authority, and that here the objection which was raised was not in their interest as a road authority at all. As to the fourth objection, the Postmaster-General had applied to the Corporation for their consent, and because they withheld it the matter had been referred to him in pursuance of the Telegraph Act, 1878. If the Corporation were right no difference, in the sense of the Act, could have arisen between them and the Postmaster-General. He was of opinion that no relevant or sufficient reasons had been stated by the Corporation for declining to give the consent required by the Postmaster-General, and he was therefore prepared to give consent, as he was empowered to do by the third section of the Telegraph Act, 1878. No expenses were allowed.

Irish Telephones.—There is a movement among some of the Irish municipalities in the direction of an application to the Postmaster-General for a trunk telephone line between Waterford, Carrick, Clonmel, and Tipperary.

Manchester Telephones.—At a recent meeting of the committee for obtaining an independent telephone service for Manchester, Salford, and district, it was resolved to send a Manchester deputation to wait upon the Financial Secretary to the Treasury to place before him the views of "this commercial centre" in favour of granting a license to the Mutual Telephone Company. The Manchester Corporation Select Telephone Committee has notified that it does not desire to take part in this deputation. A Corporation deputation, it will be remembered, conferred with the Postmaster-General last November and heard his views on the matter.

The National Company's Bills.—Wednesday's conference at the Guildhall passed the following resolutions, viz:—"That in the opinion of this conference, representing the London County Council, the Corporation of London, and the vestries and district boards of the metropolis, the Bills being promoted by the National Telephone Company in Parliament should be most strenuously opposed"; "That the authorities represented at this conference be requested forthwith to petition against the said Bills, and to ask their representatives in Parliament to oppose the Bills on second reading, and to take every possible measure to prevent the same from becoming law"; and "That a copy of the resolutions and proceedings of this conference be forwarded to the Prime Minister and Earl Kimberley, Mr. A. J. Balfour, Mr. Hanbury, Sir Henry Campbell-Bannerman, the Postmaster-General, and the various authorities represented at this conference."

Protest against the German Cable Scheme.—It is stated in the *Times* that Sir Nicholas O'Conor, the British Ambassador, has made representations to the Turkish Government in support of the protest made by the Eastern Telegraph Company against the concession given to Germans for the laying of a cable between Kustendji and Constantinople.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
French Company's cables—		
New York-Hayti ...	Feb. 10th, 1899 ...	...
Paramaribo-Cayenne ...	Feb. 10th, 1899 ...	...
Dakar-Bathurst	Feb. 9th, 1899 ...	...
Ceara-Pernambuco	Feb. 19th, 1899 ...	Feb. 21st, 1899
Landlines.		
Lines near La Paz, Bolivia...	Feb. 1st, 1899 ...	Feb. 24th, 1899.
Lines North of Japan (between Fukuoka and Moji)	Feb. 17th, 1899 ...	Feb. 22nd, 1899.
Lines near Fao (between Bagdad and Bassora) ...	Feb. 16th, 1899 ...	...
Communication with Interior of Nicaragua, except Rivas	Feb. 24th, 1899 ...	...
Siberian Lines between (Nicolsh-Wladiwostock)...	Feb. 25th, 1899 ...	Feb. 26th, 1899.

(*Continued on page* 341.)

THE CITY OF LONDON ELECTRIC LIGHTING COMPANY'S WORKS.

We have recently had an opportunity of inspecting the works of the City of London Electric Lighting Works, and the following details are of interest :—

The Corporation of the City of London discussed the question of lighting the City by electricity for many years previously to 1889, when they invited tenders for the supply of electric light to the City. At that time some towns and other districts in London were supplied with electrical energy, in most cases by private enterprise, and though the progress of the growth of such undertakings had been encouraging, they had not then developed into the sound financial condition in which they now stand.

In accordance with the agreement with the Corporation, provisional orders for the three districts were obtained by the contractors in 1890.

The Corporation, by the contracts, imposed exceptional and onerous conditions on the contractors. Such conditions included, amongst others, the lighting of the streets of the City practically at cost, the provision of depreciation and reserve funds, and the reduction of charges on the sliding-scale principle after a certain profit had been made.

In consideration of the serious risk and obligations undertaken by the contractors, the Corporation on its part granted, as far as it was able to do so, the exclusive right of supplying electricity for private purposes for 21 years from 1890.

View of Brush Alternators from the Middle of the Works.

The most sanguine advocates of electric lighting considered the prospects of successfully supplying electrical energy in the City of London were not so certain as to justify the large outlay required, and as the City authorities made unusual stipulations as to the adoption of a graduated scale of charges, terms of purchase, and provisions for depreciation funds, it is not surprising that some difficulty was experienced in getting responsible contractors to undertake the work.

The City was eventually divided into three districts, and contracts were entered into by the Corporation with two firms of manufacturers of electrical plant and machinery, with permission to transfer the contracts to an electric lighting company.

The City of London (Pioneer) Electric Lighting Company was formed to give the necessary financial assistance to the contractors to enable them to commence the work of lighting the City by the contract dates, and to give sufficient time for the great amount of work necessary before the present company could be placed before the public.

The present company was issued in July, 1891, and there is no doubt but that the capital was subscribed on the faith of the contracts with the Corporation, and there are at the present time about 3,000 holders of debenture stock and shares of the company who have invested their money (many of them having done so at a large premium) in the electric lighting of the City, relying upon the terms of the contracts with the Corporation being maintained. If the contracts

GENERAL VIEW SHOWING ONE-HALF OF THE WORKS.

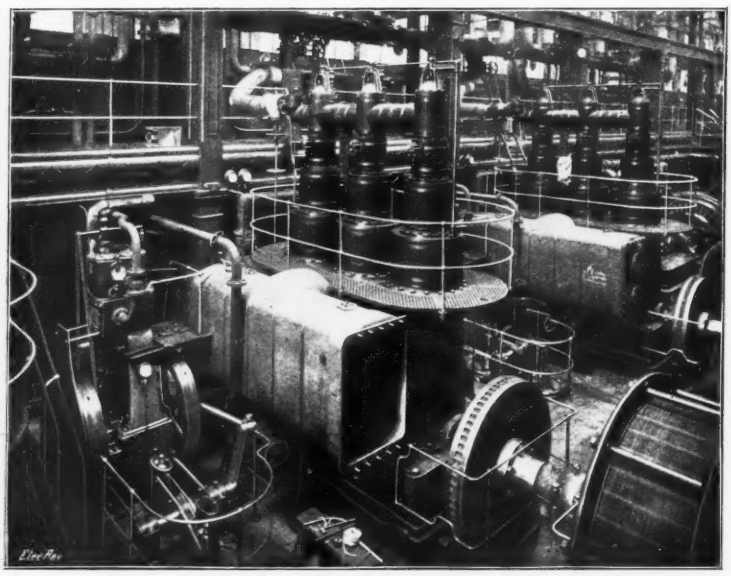
General View of City of London Electric Lighting Company's Works from Overhead Traveller.

with the Corporation are not maintained, the possibility of raising capital for industrial enterprises upon the contracts made in good faith with the municipalities will be imperilled.

With the consent of the Corporation and of the Board of Trade the respective contracts and provisional orders were transferred by the two firms of contractors to this company. This company also took over the assets, consisting of works executed and cash in hand, of the Pioneer Company, and gave a bonus of £25,000 to the shareholders of that company for the risks they had run in rendering themselves liable for £100,000. The risks were serious, as had the present company not been formed the Pioneer Company's shareholders would have lost all their money.

The original contractors supplied further plant to the company, and the contracts with them for the supply of plant were cancelled by mutual agreement in 1896. The result is that at the present time no less than 11,660 kilowatts of plant are available for the purposes of the company, and the cost of this plant, together with all land, buildings, street mains, &c., now amounts to £1,374 689, or at the rate of £117 per kilowatt. This is no doubt a moderate figure, for many other towns and companies have expended a much greater amount.

It is doubtful, however, whether any truly useful purpose is served by entering into comparative figures, for local conditions vary so enormously that the cost per kilowatt is apt to become misleading. No one could, however, deny the great difficulties existing in the way of building up a large supply system in the City of London and the company has generally met these with success.



Single Set Showing Separate Condensing Arrangements.

Works.

The power works are situated at Bankside, on the south side of the river, and are placed on a site having river frontage and extending over several acres.

The buildings are massive and substantial, and yet ornamental, the frontage to Bankside being an imposing object in this busy thoroughfare.

A lofty building has been erected on the wharf, and is connected to the main building on the other side of the road by a bridge placed at an elevation of 50 feet.

A fleet of barges is employed to bring the coal alongside this wharf, and a complete equipment of hydraulic appliances is placed in the building capable of hoisting the coal and other materials to a capacious bunker and store room on the top of the building. On the ground floor of this building the pumping machinery is placed, for the purpose of drawing water from the Thames for condensing purposes. Centrifugal pumps are employed, two being driven by steam engines, and a smaller set are connected to electric motors.

The water is drawn up from the river through large pipes, which are laid several feet below the level of the river bed, and a complete system of valves enables these pipes to be controlled as required, for there are three main pipes which can be used as suction or discharge pipes, and by constantly changing the direction of the flow of water through these pipes, it is possible to prevent the deposit of mud, and always keep them clean.

On entering the works from the Bankside frontage, a large circular water strainer will be noticed placed in the line of the condensing water pipes. The object of this strainer is to intercept the large quantity of straw, fibre, and other vegetable matter (with an occasional dog or cat), and though considerable difficulty was at first caused by this accumulation of undesirable refuse, it is now completely overcome by this apparatus. The machine consists of a slowly rotating wheel, filled with deep straining grids, the small amount of power required to drive it being supplied by an electric motor.

The engine room is one long building having a gallery on each side, the dimensions being 430 feet long and 45 feet wide. The walls are built with white glazed bricks with some ornamentation, the advantage of cleanliness in a building of such importance being most essential.

In the centre of the controlling gallery offices are placed, having a view of the whole length of the room, and here the superintendent of the works and his assistants conduct the general control of the works. These offices are fitted up with a complete telephone exchange, connecting all parts of the works, and the numerous distributing centres in the City.

Engines and dynamos of all sizes will be seen in this room, amounting in all to 30 sets of plant, the largest being capable of giving an output of 1,500 kilowatts, or about 2,500 indicated horse-power.

The output from these machines is controlled by two distinct main switchboards placed on the gallery together with subsidiary switchboards for other purposes.

These switchboards are constructed entirely of incombustible material, and while simplicity has been the leading object, every effort has been made to secure safety in dealing with the enormous amount of power they control.

Three travelling cranes will be noticed, capable of dealing with any weight up to 45 tons; all these cranes are driven by electric motors.

The gallery on the opposite side of the room is known as the steam gallery, and provides every convenience for manipulating the steam valves to each engine, and also the large valves in the main steam pipes. This arrangement has been found of great utility, as complete command of the steam plant is secured, and facilities are given to shut off or discontinue any line of piping.

A feature of some interest is the arrangement of the water service to feed the boilers, as the whole of the work is performed from the gallery and is quite distinct from the ordinary work of the stokers. A large variety of boiler feed pumps are employed, some being remarkable for the small space they occupy, and others are unusually large.

The boiler house adjoins the engine room, and contains 33 large water-tube boilers all fed by automatic stokers which receive the fuel by chutes or tubes from the coal store overhead.

This coal store contains about 2,000 tons of coal, all of which is transported from the wharf bunker by means of a coal conveyer consisting of a long chain with broad links which push the coal along a trough.

A similar conveyer removes the ashes from the boiler house and deposits them into a bucket elevator which enables them to be deposited on the wharf for removal.

Other buildings contain machines for the arc lighting of the streets of the City, and continuous current for motive power supply.

(*To be continued.*)

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 336.)

The Telegraph on the Congo.—The *Times* says that the telegraph is steadily making its way across Central Africa by the side of the Congo river. News has just been received in Brussels of the laying of the wire to a point 800 miles east of Boma. This must be in the vicinity of the important station of New Antwerp. The *Belgique Coloniale* gives the following instance of the consequences resulting from this improved means of communication:—"A telegram despatched from Kuamouth, at the junction of the Kassai and the Congo, on January 15th, was delivered at Boma half an hour later. For the future the Kassai is thus placed in direct and rapid communication with the seat of Government, and Europe is also brought close to the centre of Africa. Only a few years ago news took at least two months to reach Boma from the Kassai, and the reply would not be received under another two months, and this only if the parties were available and the steamer ready to start."

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—March 10th. The Electric Lighting Committee wants tenders for the supply of copper strip. See "Official Notices" this week.

Belfast.—March 16th. The Electric Committee wants tenders for switchboard extensions. See our "Official Notices" February 24th.

Brighton.—March 6th. Tenders are invited by the Council for a 20-ton travelling crane for the electricity works. See "Official Notices" February 24th.

Bury.—March 20th. The Electric Lighting Committee wants tenders for a Lancashire boiler with steam and other pipes. See "Official Notices" this week.

Canterbury.—March 14th. Tenders are wanted for boiler house plant, engine house plant, extensions of switchboard and mains. See our "Official Notices" February 17th.

Dundee.—March 15th. The Gas Commissioners are inviting tenders for four Lancashire boilers, two 450-H.P. steam engines and dynamos, and one 700-H.P. steam engine and dynamo. Particulars from the electrical engineer, Mr. W. H. Tittensor. See our "Official Notices" February 17th.

Edinburgh.—March 6th. Tenders are wanted for condensing plant with water cooling tower, feed water tanks and filters for the electricity works. The Corporation also wants tenders for electric lighting installation at Tollcross tramway power station. See our "Official Notices" February 17th for particulars of both contracts.

Glasgow.—March 15th. The Corporation wants tenders for the reconstruction of tramways according to specification. See our "Official Notices" this week.

Greenock.—March 3rd. The Police Board wants tenders for the supply and erection of boiler-house plant, engine-house plant, and overhead travelling crane for their electric works (low tension). See our "Official Notices" February 17th.

Greenock.—March 16th. The Police Board wants tenders for mains, arc lamps, poles, &c. See "Official Notices" this week.

Hammersmith.—March 15th. The Vestry invites tenders for water-tube boilers, 1,000-H.P. slow speed engines, and two 60-kw. alternators, feeders, and cast-iron pipes. See "Official Notices" February 24th.

Huddersfield.—February 27th. The Electricity Committee wants tenders for mechanical coking stokers, also for a complete switchboard. See our "Official Notices" February 17th.

Lewes.—March 24th. The Corporation is prepared to receive offers from those willing to establish an electricity supply undertaking. See our "Official Notices" February 17th.

London.—The Asylums Committee of the London County Council invites tenders for the supply of electric light sundries to the Claybury and Heath Lunatic Asylums for one year from April 1st. Particulars obtainable at the Committee's offices, 6, Waterloo Place, S.W.

London.—March 14th. The Great Central Railway Company are prepared to receive tenders for the supply, during the 12 months ending April 30th, 1900, of the undermentioned material: electric light materials. Sealed tenders endorsed "Tender for ——" to be in the hands of Mr. Oliver S. Holt, secretary, not later than 10 a.m. on Tuesday, March 14th.

Pernambuco.—March 18th. The Government of the State of Pernambuco invites tenders for the construction of an electric tramway to run between that city and Olinda, situated at about three miles distance. Tenders, duly sealed, must be addressed to the "Secretaria da Industria," Pernambuco, and should be received there not later than March 18th. Further particulars may be obtained on application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Poplar.—The Guardians wants tenders for steam turbines and dynamos (direct coupled), electric motors, accumulators, cables, wiring and fittings, distribution, and switchboards. See our "Official Notices" February 24th.

Southampton.—March 6th. The Corporation wants tenders for the supply of stores, &c., required in the electricity department for 12 months. Specifications, &c, at the electricity works.

Southend-on-Sea.—April 6th. The Corporation wants tenders for the "temporary" transfer of their 1891 Electric Lighting Order. See "Official Notices" this week.

Spain.—March 16th. Tenders are being invited until March 16th by the municipal authorities of Betanzos, for the concession for the electric lighting of the public streets. Tenders are to be sent to El Secretario del Ayuntamiento de Betanzos, Spain, whence particulars may be obtained.

Stockport.—March 9th. The Gas and Electricity Committee invites tenders for two 140-kw. shunt wound dynamos. See "Official Notices" February 24th.

Stockport.—March 24th. Tenders for electric lighting the Stockport Sunday School are invited to be sent in to the Secretary not later than March 24th.

Wolverhampton.—Tenders are being invited for the supply of small electric launches for lake use. Particulars from Mr. J. W. Bradley, borough surveyor, Town Hall.

CLOSED.

France.—The French Corporation of Telegraph Authorities in Paris have placed a contract with La Société Industrielle des Telephones, of 25, Rue de Quatre, Septembre, Paris, for 25 kilometres of lead-covered 3-conductor cable, and 17 kilometres of 2-conductor cable at £4,478.

Islington.—Messrs. Johnson & Phillips have secured the contract for the supply of electrical stores to the Islington Vestry.

Liverpool.—The tenders submitted for 20 new electric cars were as follows:—Messrs. Dick, Kerr & Co., £498 each; the Brush Company, £500 each; the Westinghouse Company, £550 each; and the British Thomson-Houston Company at £569 each. It has been decided, upon the recommendation of the engineers, that, as these different cars would be fitted with first-class electric appliances of a new pattern, it was advisable for the purpose of testing the utility of those appliances in actual working to order ten cars from Messrs. Dick, Kerr & Co., five from the Brush Electrical Engineering Company, and five from the Westinghouse Company.

FORTHCOMING EVENTS.

Friday, March 3rd.—At 8 p.m. The Institution of Junior Engineers, Westminster Palace Hotel. Paper on "Carbon Consuming Batteries and their Possibilities," by W. R. Cooper, B Sc. M.I.J.E., illustrated by experiments.

Saturday, March 4th.—The Institution of Electrical Engineers. Students' visit to the works of Messrs. Easton, Anderson and Goolden, Erith. Train leaves Charing Cross at 10 a.m.

Thursday, March 9th.—At 8 p.m. The Institution of Electrical Engineers.

Friday, March 10th.—At 5 p.m. Physical Society. "A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids," by Albert Griffiths, M.Sc.; "Note on the Source of Energy in Diffusive Convection," by Albert Griffiths, M.Sc.; An Exhibition of Dr. A. Wehnelt's Electrolytic Current Interrupter for Ruhmkorff Coils, by A. A. Campbell Swinton.

Saturday, March 11th.—Institution of Junior Engineers. Conversazione at Westminster Palace Hotel. Reception at 7 p.m. by the president, Sir W. H. White and Lady White; the chairman, Mr. B. H. Joy and Mrs. David Joy

NOTES.

Obituary.—On Saturday last Baron Paul Julius de Reuter passed away, at Nice, in his eighty-third year. At the very introduction of practical telegraphy the late baron laid the first stone in the foundation of that world-renowned telegraphic news agency, Reuter's Telegram Company. We cannot afford space to refer in detail to the enormous difficulties which had to be overcome in the early days of so important an undertaking, but the Baron's indomitable energy and enterprise were sure to bring success. In addition to utilising the telegraphic system for the transmission of news, De Reuter was responsible for the laying of new lines, for, says the *Times*, in 1865 he obtained from the Hanoverian Government a concession for the construction of a submarine telegraph line between England and Germany which enabled a through telegraphic communication to be made direct between London and the principal towns of his native country. He also acquired from the French Government the right to construct and lay a cable between France and the United States. This was laid in 1865, and was worked in conjunction with the Anglo-American Telegraph Company. Twenty-four years ago Baron de Reuter converted his agency into a limited liability company, retaining, however, the managing directorship. In 1878 he retired from this position, though he still continued as an ordinary member of the board. He was succeeded in the post of managing director of the company by his son, Mr. Herbert de Reuter. Baron de Reuter's title was conferred upon him in 1871 by the then Duke of Saxe-Coburg and Gotha.

The Civil and Mechanical Engineers' Society.—At a meeting of this society on 16th ult., Mr. Holroyd Smith, M.I.M.E., M.I.E.E., delivered an interesting lecture on "Some Methods of Collecting the Current in Electric Tramways," prefacing his remarks by a brief statement of the principles that govern the conversion of dynamic energy into electric, and the reverse. In dealing with the methods of collecting the current, reference was made to the various systems of electric traction and a brief *résumé* of the history from 1832 to the present day was given. By means of numerous diagrams he showed the construction and details of nearly every known collector for underground, with closed or open conduits, and for overhead with tubes, wires, &c., describing the brush, the bar, the shuttle, and the trolley; and exhaustively compared the relative advantages of rolling and sliding contact, giving preference to the latter. He considered that the electrical world was largely indebted to Sprague, of America, who he believed to have been the first to introduce the trolley bar collecting the current from the underside of an overhead wire. The conditions pertaining thereto were carefully analysed, the difficulties and requirements considered, some interesting examples illustrated and described, and models shown. A discussion followed.

Flying Machines.—In the course of a discussion on ballooning at the Society of Arts, one speaker (Mr. H. Fentum Phillips, A.M.I.E.E.), in referring to the great expense attaching to experimental work upon such things as flying machines, aeroplanes, &c., suggested that a council or committee be formed of, say, members of the Society of Arts, the Institutions of Civil and Electrical Engineers, the Royal Institution, the Aeronautical Society and kindred bodies, the said committee to pursue the investigation of the subject voluntarily, a grant being made by Parliament to meet the expenses connected with actual work. The speaker thought that this would lead to some practical vessel being built.

Electric Power in Western Australia.—The *Australian Mining Standard* says that a company is being formed, called the Kalgoorlie Goldfields Electromotive Power, to establish a central power station for the Kalgoorlie (W.A.) goldfields. The capital will be £500,000, of which the mines will subscribe half. It will be 5,000 horse-power, and it is calculated the cost of working the mine will be reduced 25 per cent. The company will be the largest of its kind in the world; but it is expected that the capacity of 5,000 horse-power will not be sufficient, and that the plant will have to be largely increaseed.

The Volta Centenary.—The *Times* Zurich correspondent writes:—"A Volta commemoration is to be held next May at Como, which was the birthplace of the great electrician, and where he died in 1827. The *fêtes* at Como are to celebrate the centenary of Volta's discovery of the electric pile, in honour of which event a great exhibition of inventions in electricity will be opened on May 14th, the town contributing some 500,000 francs to the preliminary expenses. The small Italian city has always been very proud of its greatest citizen, and Volta's memorials are carefully preserved in its Museo Civico, where one can see his first electric pile, many of his scientific instruments, an electric pistol, and an electric lamp of his invention, besides many of his manuscripts sketches, and designs. Exhibits are announced from all parts of Europe and America, and a congress of electricians and telegraphists will be held at the same time. In connection with the Volta commemoration an important exhibition of Italian silk industries will be opened simultaneously with the electric exhibition. The exhibition buildings face the lake, on which the latest inventions in electric boats and launches will form a conspicuous feature of the *fêtes*. Volta's electric pile was first described in England in a letter to Sir J. Banks, then president of the Royal Society. This letter is dated March 1st, 1800, and was read before the society on June 26th of the same year."

The Colombo Electric Tramways and Electric Lighting.—The first portion of this tramway service was recently opened, and in spite of an unpleasant demonstration which was made at the trial by a number of "Rickshaw" coolies, who look at the cars with great ill-feeling, apprehending a loss to their industry, the regular service between the jetty and central station has been successfully commenced. The generating station contains at present a 225-kilowatt dynamo coupled to a McIntosh & Seymour engine. There are two other similar engines, which will work the other machines and also provide for a reserve in case of a breakdown. At present one engine is sufficient to work the few cars which are in service and also furnish current to the old electric light station which is some distance off, the current being taken by means of a large cable, supported the greater part of the way on the overhead wire standards. By means of a motor dynamo it is transformed from 500 to 200 volts. Thirty arc lamps are already erected in the principal business quarter known as the Fort. The contractors, Messrs. Boustead Bros., of Colombo, have agreed to a certain number of hours lighting each month, the exact amount being fixed by the Municipal Council, who, in common with other officials in the East, consider that if a moon is shown in the calendar it is moonlight, whether the sky is clouded or not and no light is provided under these circumstances, although the darkness is Cimmerian. It is intended to extend the arc lighting to other thoroughfares, and it is to be hoped that the City Fathers will see fit to give up their rights in the moon and allow the hours of lighting up to be independent of that unsatisfactory illuminant. The concession for the tramways was originally granted to a Mr. Matthews; the scheme was then submitted to Mr. Killingworth Hedges, C.E., on behalf of a London firm who were arranging to form a company; however, before matters could be settled in Colombo, the concession was allowed to lapse and the proposed company was abandoned. Messrs. Boustead are to be congratulated in having smoothed over the difficulties with the Municipality, and have shown that it is often easier to promote an enterprise locally than to float a company at home for a similar object, however meritorious it may be.

Great Engineering Combination.—The *Carriage Builders' Journal and Rolling Stock Record* announces that a powerful trust is being formed for combining the whole of the concerns engaged in one of the largest and best known branches of the British engineering trades. It is expected that the capital will be little short of 10 millions sterling.

Gas v. Electricity.—A director of the Eastbourne Gas Company informed the shareholders recently that "he thought that the changes in gas lighting introduced during the past few years had been so great that electricity would have considerable difficulty in coming to the front." The speaker sees through a glass darkly.

Electric Timber Seasoning.—The Nodos Bretonneau process of timber seasoning by electricity, which has recently been brought to notice in this country, involves (1) the total expulsion of the sap; (2) the replacement of the sap by a solid matter, which is insoluble and aseptic, thus rendering the wood imputrescible. The wood is placed flat in a vat containing a lukewarm solution, which solution covers the timber to within a distance of about 2 inches from the top at the commencement of the operation, and is gradually lowered towards completion of the process. An electric current under the necessary difference of potential crosses the thickness of the wood, entering from the lower part, which is connected to the positive pole, and coming through the top, which is connected to the negative pole of the dynamo. By the action of the current the solution is sucked from the bottom to the top, and permeates the whole mass of wood by electro-capillary attraction. The displaced sap rises to the surface of the bath during the operation, which lasts from five to eight hours, according to the nature and state of the wood under treatment. The solution used for the simple process of seasoning and preserving the wood is a composition called "Bororesinate de Soude," the rosin of which seals the fibres of the wood after cooling, and the boric acid acts as an antiseptic. The duration of process is very variable, according to the nature of the wood, its thickness, the season of the year, &c., but it may be taken as varying from between two weeks to two months. The sap being replaced by a solid and insoluble matter, no longer ferments by heat, and having become refractory to the absorption of water, does not swell during damp weather. The treatment is doubly aseptic by the disappearance of the sap, and its replacement by dead matter. It thus prevents the wood from being attacked by chemical agents, by insects, and by animalculæ, which produce mould and rot. Although there appears good reason to believe that the process is founded on sound reasoning, it is, perhaps, a little premature to speak of the same as being a success. Time, *edax rerum*, can alone determine this.

Coherers.—On Friday night Dr. Oliver Lodge lectured at the Royal Institution on "Coherers," Sir Wm. Crookes being the chairman. Beginning with a short explanation of the nature of coherers, which he defined as devices sensitive to ether waves in such a way as to establish better electrical connection than existed before, he went on to show a number of experiments illustrating cohesion, which, he said, was the physical force of which least was known, with the exception of gravitation. His first experiments, says the *Times*, showed the effect of electrification in preventing the drops of water in a jet from scattering, and in causing two jets to unite. He next showed how, under the influence of electric action, soap bubbles united, and a smoky atmosphere cleared, the floating particles of dust cohering into flakes. Dealing next with the cohesion of metals, he spoke of the experimental detection of Hertz waves, mentioning in particular two workers—Prof. Minchin and M. Branly. The latter found that the electrical resistance of metallic powders decreased under the influence of Hertz waves—a fact on which depended Mr. Marconi's system of wireless telegraphy. In conclusion, the lecturer performed some experiments to illustrate the cohesion of metallic filings while affected by Hertz waves. In one of these the filings were placed on a brass ball with a flattened top, and it was shown how, by means of a vertical wire, they could be pulled up in a chain just as if they were magnetic.

Lectures.—Mr. J. S. Critchley, M.I.M.E., manager of the Daimler Motor Company's works at Coventry, gave an interesting lecture on February 24th to the members of the Coventry Engineering Society, upon the construction of motor cars.

Under the auspices of the Dumbarton Mechanic's Institution, Mr. Stuart Paterson delivered a lecture, entitled "Current and Coil," on 23rd ult., in the Burgh Hall, Dumbarton.

On 21st ult. Mr. E. H. Crapper, lecturer on electrical engineering at the University College, Sheffield, lectured at Attercliffe on "Electric Traction as Applied to Tramways, &c."

New Copper Mining Developments.—The prospectus of "The Copper King Mining Company" recently appeared in the daily papers. The capital of this company is to be £350,000, of which the vendors of the mine take £250,000 in shares and £25,000 in cash in satisfaction of their claims. The mining property is situated at Fresno, in California, covers 90 acres, and has been worked by the vendors, Messrs. F. L. Gardner and D. Dalziel, since 1896. The development has now been carried sufficiently forward to warrant the erection of a smelting plant at the mine. The ore contains from 3½ to 9¼ per cent. copper, and 3—4 dwts. gold, and 3—4 ozs. silver per ton. The mine is at present yielding 50 tons ore per day, and it is expected that it will shortly be producing double this amount. The present high price of copper is causing attention to be directed to old and abandoned copper mines, which though unprofitable when copper was selling at £48 per ton, are capable of earning profits under the present conditions of the market. We learn from the *Aluminium World* that the Inguaran Copper Mines, situated near Ariode Rosales, Mexico, are being prepared for re-working. These mines were bought some time ago by a Rothschild syndicate. They are at present being drained of water, and a railroad to the coast is being planned. Another copper-producing district which, according to the *Engineering and Mining Journal*, will shortly become of importance, is the Chillagoe copper district of Queensland. The ore found in this locality carries copper, lead, and silver, and though some portions of the ore beds are valueless, there still remains a very large quantity of workable ore. A railroad to the coast is one of the first things required to adequately develop this mining district. The recent returns published with commendable promptitude in the same paper show that the United States still stands easily at the head of the copper-producing countries of the world. The 1898 output is estimated to be 247,332 metric tons, as against 231,421 tons in 1897. This is nearly two-thirds of the world's output. The exports in 1898 are estimated to have been 138,100 long tons, or 56 per cent. of the production.

Insulators for Low Temperature Work.—To maintain extremely low temperature by means of freezing substances requires careful insulation. Prof. W. Hempel finds that eider-down is the best insulator, carefully dried wool being nearly as good and cheaper, and that both are much better than the specially devised vacuum-jacket tube of Prof. Dewar. *Invention* says that starting at about 110° below zero F., the rise in temperature under protection of the eider-down was only 22° in 88 hours, while in the Dewar tubes the increase was 70° to 124°.

Acetylene Gas Exhibition.—The programme of the Second International Exhibition of Acetylene Gas in connection with the Buda-Pesth Acetylene Congress, is now issued, and forms of application for space can be obtained from the Committee of Management and the Executive Council. The Congress will last from May 20th to May 24th, and the exhibition from May 14th to 28th. They will be held at the Industrial Palace in the Town Park, Buda-Pesth.

L.C.C. and Electric Traction.—The L.C.C. on Tuesday adopted the proposal (printed in our last issue) to appoint Prof. Kennedy to inquire into mechanical traction systems for London.

Institution of Civil Engineers.—On 23rd ult. Mr. W. H. Preece, C.B., the president, entertained the honorary members and council of the above Institution to dinner.

Northern Society of Electrical Engineers.—On Tuesday, at Manchester, Mr. S. Z. de Ferranti, the president-elect for the year, delivered his presidential address to the above society.

The Municipal Trading Clauses.—We understand that the Chairmen of Committees have decided to strike out the electrical trading clauses in the Bills of the 70 municipal authorities.

The Carlin Tube.—In the *Journal of the Chemical and Metallurgical Society of South Africa*, Vol. 1, page 63, we notice a paper by A. von Dessauer on the Carlin tube. The tube consists of an ordinary iron pipe, ½ inch in diameter, closed at its ends with screw plugs and filled with mercury. As many holes as there are electrodes are drilled in the top, from end to end, as it lies horizontally, of sufficient size to allow the copper connecting wire to pass through easily and dip into the mercury. The electric main is affixed to one or both of the end plugs in a convenient manner. The pipe may also be made of copper or brass, when there will be a risk of amalgamation; or it may be replaced by a solid iron rod with one long groove, or a series of small cavities to hold the mercury. With this system of connection there is practically no loss of tension of current, experiments showing, with an 8-feet tube with 52 cathode connections, a loss of only 0·3 per cent. as compared with a loss of 18·4 per cent. with the ordinary mercury trough connection. The intensity of current is evenly distributed, and the connection is rapid and perfect, and without the possibility of becoming dirty or oxidised. Furthermore, there is no heating of the mercury, nor loss by evaporation or spilling.

Personal.—We understand, on excellent authority, that Major Cardew is leaving the Board of Trade. He has entered into partnership with Mr. W. H. Preece and his son, and they will together practise as consulting engineers.

Appointment Vacant.—The Manchester Tramways Committee want a manager for their car building and repairing works. See our "Official Notices."

NEW COMPANIES REGISTERED.

Lindsay, Browning & Company, Limited (60,757).—This company was registered on February 18th, with a capital of £1,000 in £1 shares, to acquire the business carried on by Frederic L. L. Lindsay and Ernest F. Browning, at Bangor, Carnarvon, as "Lindsay, Browning & Co.," and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity and electrical apparatus makers. The first subscribers are:—James Eastern, Menai Bridge, Anglesey, gentleman, 5 shares; Mrs. Hannah Browning, Menai Bridge, Anglesey, 5 shares; Mrs. F. L. L. Lindsay, Glyngarth, Anglesey, 1 share; Ernest F. Browning, Menai Bridge, Anglesey, engineer, 1 share; Frederic L. L. Lindsay, Glyngarth, Anglesey, engineer, 1 share; Lewis G. Harding, 2, Glandwr Terrace, Bangor, clerk, 1 share; W. Douglas-Jones, Bangor, solicitor, 1 share. The number of directors is not to be less than two nor more than five, the first are the said two vendors; qualification, £25; remuneration, as fixed by the company. Registered office, 216, High Street, Bangor.

Commercial Telegraph Construction Syndicate, Limited (60,772).—This company was registered on February 20th, with a capital of £5,000 in £100 shares, to adopt an agreement with the Hon. James Roche, and to subscribe for, or otherwise acquire, and hold any of the shares, stock, or securities of the Northern Commercial Telegraph Company, Limited, incorporated by an Act of the Canadian Parliament. The first subscribers (each with one share) are:—James Roche, M.P., 43, Ebury Street, S.W.; Henry S. Holt, 6, Gray's Inn Square, W.C., solicitor; Anthony Raymond, 9, Tokenhouse Yard, E.C., gentleman; Fred. I. Abbott, 39, Lombard Street, E.C., gentleman; B. W. Bell, 94, Piccadilly, W., gentleman; B. H. M. Ritchie, 108, Jermyn Street, S.W., gentleman; C. H. Gurney, 23, Ilchester Mansions, Kensington, gentleman. Registered without articles of association.

Ingleton Electric Lighting and Power Company, Limited (60,796).—This company was registered on February 22nd, with a capital of £4,000 in £1 shares, to supply electric light, heat, and power at Ingleton, Yorkshire, and elsewhere. The first subscribers (each with one share) are:—William Metcalfe, Fell End, Ingleton, Yorkshire, farmer; John C. Watkin, Glenholme, Ingleton, Yorkshire, solicitor; John Brookes, Main Street, Ingleton, printer; Richard Atkinson, The Grange, Ingleton, gentleman; Charles Ferguson, 2, Gretna Cottages, Ingleton, Yorkshire, engine driver; William Fisher, Main Street, Ingleton, Yorkshire, innkeeper; William Mackay, Main Street, Ingleton, Yorkshire, cabinet maker. Registered without articles of association.

Nernst Electric Light, Limited (60,807).—This company was registered on February 23rd, with a capital of £320,000 in £1 shares (of which 140,000 are 7 per cent. preference), to acquire certain rights connected with an invention known as "The Nernst Lamp," to carry on the business of electrical lamp manufacturers and dealers, manufacturers of and dealers in electrical apparatus, electrical and mechanical engineers, electricians, suppliers of electricity, &c., and to enter into an agreement with "The Nernst Lamp, Limited." The first subscribers (each with one share) are:—John G. Fort, Forest Lodge, Ashstead, Surrey, gentleman; Geo. F. Honig, 10, Alma Square, St. John's Wood, N.W., clerk; William Andrew, 38, Hornsey Park Road, Hornsey, book-keeper; Frederick W. White, Hollywood, Browning Road, Manor Park, E., clerk; Charles M. Robertson, 12, Fenchurch Street, E.C., merchant; John G Forster, 12, Fenchurch Street, E.C., clerk; and Edgar Bois, 12, Fenchurch Street, E.C., merchant. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £250; remuneration, £1,200 per annum and 10 per cent. of the net profits when 7 per cent. per annum has been paid on all the shares, divided between them. Registered office, Dashwood House, New Broad Street, E.C.

Pioneer Electric Light and Power Company for Japan, Limited (60,811).—This company was registered on February 23rd, with a capital of £3,000 in £1 shares, to acquire and deal with, in the Empire of Japan or elsewhere, any rights, concessions, or privileges for generating, supplying, distributing and employing electricity, gas, or other light and power. The first subscribers (each with one share) are:—James A. Kelman, 51, Highbury New Park, N., solicitor; James A. Kelman, jun., 24, Leconfield Road, N., electrical engineer; Charles S. Kelman, 316, Winchester House, E.C., merchant; Douglas E. Kelman, 48, Artillery Lane, E.C., manufacturing chemist; Adam McIntosh, Craigella, Kelross Road, N., publisher; Edwin A. King, 49, Rylett Crescent, Shepherd's Bush, W., accountant; and Geo. C. Eedes, 85, Isledon Road, Finsbury Park, N., clerk. The first directors (to number not less than three nor more than five) are to be appointed by the subscribers; qualification, 50 shares.

Pioneer Electric Light and Power Company for China, Limited (60,814).—This company was registered on February 23rd, with a capital of £3,000 in £1 shares, to acquire and deal with the right to supply electricity, gas or other light and power in the Empire of China or elsewhere, and to carry on business as electricians, electrical and mechanical engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—James A. Kelman, 51, Highbury New Park, N., solicitor; James A. Kelman, jun., 24, Leconfield Road, N., electrical engineer; Charles S. Kelman, 316, Winchester House, E.C., merchant; Douglas E. Kelman, 48, Artillery Lane, E.C., manufacturing chemist; Adam McIntosh, Craigella, Kelross Road, N., publisher; Edwin A. King, 49, Rylett Crescent, Shepherd's Bush, W., accountant; and George C. Eedes, 85, Isledon Road, Finsbury Park, N., clerk. The first directors (to number not less than three nor more than five) are to be nominated by the subscribers; qualification, 50 shares.

Electro-motors, Limited (60,826).—This company was registered on February 24th, with a capital of £50,000 in £1 shares, to enter into an agreement with Claude W. Atkinson and William H. Johnson, and to carry on the business of manufacturers of electric and other motors, motor cars, locomotives, dynamos and electrical apparatus, electricians, electrical, hydraulic, gas, mechanical, and general engineers, waggon builders, cycle and cycle accessory makers, &c. The first subscribers (each with one share) are:—William H. Johnson, 24, Lever Street, Manchester, iron merchant; William H. Stubbs, Mill Street Works, Ancoats, Manchester, machine maker; Joseph H. Stubbs, Mill Street Works, Ancoats, Manchester, machine maker; Arthur McDougall, City Corn Mills, Poland Street, Manchester, miller; Frederick Goodbehere, Fern Bank, Plymouth Grove, Manchester, machinist; Claude W. Atkinson, Woodland Place, Penarth, South Wales, civil engineer; and Percy Stubbs, Mill Street Works, Ancoats, Manchester, machine maker. The first directors (to number not less than three nor more than seven) are William Johnson, William T. Stubbs, Joseph H. Stubbs, and Arthur McDougall; qualification, £250; remuneration as the company may decide.

Surprise Arc Lamp Company, Limited (60,836).—This company was registered on February 24th, with a capital of £2,000 in £1 shares, to acquire the business carried on at 27, Catherine Street, Strand, W.C., as "Thomas & Co.," to enter into an agreement with Wallace J. L. Sandy and Thomas Geer, and to carry on the business of electrical and mechanical engineers, suppliers of electricity, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—W. F. L. Frith, 38, Westwell Road, Streatham Common, accountant; Arthur H. Parkes, 77, Benthal Road, Stoke Newington, book-keeper; H. A. Swepstone, 31, Great St. Helens, E.C., solicitor; Frank Lloyd, 60, Sotheby Road, Highbury, gentleman; George C. Baldock, 6, St. Anna Road, Burdett Road, E., clerk; William H. Butterfield, 12, Leonard Terrace, West Green, N., clerk; and H. Perry, 24, Huddlestone Road, Forest Gate, E., clerk. The first directors (to number not more than five) are to be nominated by the subscribers.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Direct United States Cable Company, Limited (11,597).—The annual return of this company, which has just been filed, shows that out of a nominal capital of £1,300,000 in £20 shares, 60,710 shares have been taken up, and that the whole of these are considered as fully paid.

New British Incandescent Electric Lamp Company, Limited (58,316).—The statutory return of this company was filed on December 15th, when 23 857 shares were taken up out of a capital of £30,000 in £1 shares, and all are considered as fully paid.

Nernst Lamp, Limited (58,057).—This company's statutory return was filed on February 14th, when the whole capital of £17,000 in £1 shares was taken up; 5,000 shares are considered as paid and £12,000 has been paid on the others.

CITY NOTES.

City Meetings. Exceptional pressure upon our space compels us to hold over until next week our reports of the meetings of the City of London Electric Lighting Company, the Notting Hill Electric Lighting Company, and the London Electric Supply Corporation.

Telegraph Construction and Maintenance Company.

The thirty-fifth ordinary general meeting of the shareholders of the above company was held on Tuesday at the offices, 38, Old Broad Street, E.C., Sir Robert G. W. Herbert, G.C.B., presiding.

The Chairman, in moving the adoption of the report, said the directors were pleased to meet the shareholders upon that occasion, feeling hopeful that they would consider the report of the past year a satisfactory one. The net profits had amounted to £71,593 as against £61,131 in the preceding year, and they brought into the accounts £33,841 against £39,900 in the previous year. They therefore had a profit balance this year of £105 035 as against £101,071 for 1897. Having declared an interim dividend at the rate of 5 per cent., there remained £83,025 to be dealt with as against £78,660 in the preceding year. They proposed to distribute the same dividend as last year, viz., a further 10 per cent. in addition to the 5 per cent. which had already been distributed, and they would have £38,205 to carry forward as against £33,541 carried forward the previous year. That was a slight improvement, but it was not quite so much as they would like to see carried forward—in fact, it was a smaller amount than had been carried forward in most of the preceding years. But having regard to the present position of the company, they hoped that amount would place them in a good position that time next year. The works had been kept fully occupied in the manufacture of submarine telegraph cables and insulated landlines, and the steamships had been actively employed in the laying and repairing of cables in various parts of the world. That brought him to say a word or two about the addition they had made to their fleet during the year in the ss. *Anglia*, of 6,514 tons. She was a very fine vessel, and the largest telegraph steamer afloat. It had been the object of the company to provide itself with a thoroughly efficient steamer, capable of carrying the longest lengths of deep-sea cables that might have to be paid in any part of the world. Up to the present time, when a great many cables had been laid it had been necessary to employ two or more ships; but their new ship would be able to lay the largest cable without any assistance. She had only recently returned from laying, most successfully, the new cable, *viâ* Gibraltar and Malta, to Alexandria. The factories at Wharf Road and Woolwich were both in a thoroughly efficient condition, and at Wharf Road very considerable improvements had been made, which enabled them to carry out their work much more efficiently. It was very satisfactory to see that the directors had been able to renew their £150,000 debentures at 4 per cent. instead of 5 per cent., which meant a saving of £1,500 a year to the company. They proposed to establish a pension fund for the benefit of the clerical staff, and had placed £5,000 as a nucleus for starting that fund. It was very desirable that they should make provision for their staff, because it was a very excellent one, and gave the directors the highest satisfaction, and they would be very sorry to see any of them transfer their services to other companies where their future was provided for. It was hoped that the fund would be self-supporting, although they might have to come to the shareholders in another year or two to ask them to make a further contribution.

Admiral Sir A. Hoskins seconded the motion.

Replying to questions, the Chairman said that they had good prospect of employment for their works during this year, and personally he was hopeful that they would have another good year.

The report was then adopted.

The retiring directors and auditors having been re-elected, the proceedings terminated with a vote of thanks to the chairman for presiding.

W. T. Henley's Telegraph Works Company, Limited.

The ordinary meeting of this company was held on Friday last, Mr. S. Gedge, M.P., presiding. In moving the adoption of the report, the chairman congratulated the shareholders on the increase in the dividend and bonus, amounting to 2 per cent. more than they paid last year or ever before. The company had made steady progress. Since 1895 their share capital had been increased by 27 per cent., and the value of their freehold land, buildings, &c., had also advanced to the same extent; and, while their ordinary share capital was £150,000, it was represented by freehold land, buildings, &c., of the value of £150,809. In the same period of four years their stock-in-trade had increased by 166 per cent., and its value on December 31st last was £116,082. Less than 4 per cent. of this was what might be called old stock, but this had been written down every year, and they therefore had no doubt that it was by no means overvalued at the sum which it represented of a little over £4,000. The rest consisted very largely of expenditure on orders in hand. In their company they never put anything down in the shape of anticipated profit, or, in fact, earned profit, on an order in hand. If they had completed three-fourths of an order they would only put down three-fourths of the cost, but they would not take credit for the three-fourths of the profit that had been earned. The stock-in-trade also consisted of a considerable quantity of raw material, in valuing which they looked at two things—what they had paid for it and what the market price was. If the articles represented by this item had risen in value since they were bought they were put at their cost price, while if they had fallen in value they were taken at the market price. They were very careful indeed not to make an over-estimate. A considerable amount of the sum mentioned also represented stock-in-trade for which there was a demand which had to be met immediately. They used in the old days, when they had not sufficient capital, to lose orders because they could not supply the goods wanted until they had made them, but they now kept a sufficient stock of articles of this kind to meet orders immediately they received them. In regard to the current year, they were still continuing their progress with reference to orders which, up to that day, were just 28 per cent. more in value than they were a year ago, despite the fact that last year they received a very large order indeed in the very week before their meeting. This year, however, they had not had the fortune to obtain such an order, but as a rule the large orders did not yield so good a profit in proportion as the smaller orders. A year ago he told them that they had been able to issue 2,500 shares among the shareholders at the price of £16 for the £10 share, giving them a premium of £15,000, which was added to the reserve account. He told them on the same occasion that they would be issuing the rest of the shares, but that they must not expect to get them so cheaply, although he said that they would let the shareholders have them at a price to pay them well, while being advantageous to the company. The shares issued last year were therefore offered at £18 and subscribed for at that figure, and the £20,000 premium thus made was also put to the reserve fund. They were also transferring to this fund the ordinary £7,500 which for the last three years they had added to it, and the reserve account now stood at £62,500. The shares were taken up by the shareholders without the least expense by way of commission or otherwise, a point to be particularly observed at a time when so much was being said about large commissions being improperly paid by directors of companies to get out their capital. The reserve under the cable-repairing contract with respect to the Bahamas and Florida cable amounted to £5,352. This amount was increased automatically by the subsidy paid to the reserve account by the Government of the Bahamas, and, with the accumulated dividends, less anything spent in repairs, was invested half-yearly. The cable was laid in 1892, and not a shilling had been required to be expended on it yet, while less than £30 had had to be spent during this period of seven years on slight repairs to the cable hut and poles on shore. The cable laid by the company in 1891 between Halifax and Bermuda he also believed had not required any expenditure, although this was a matter not in their hands. The facts mentioned, however, showed that their under-water work was exceedingly good. Since 1895 the net profits of the company had increased by 45 per cent. and the dividends and bonus had risen gradually from 8 per cent. to 14 per cent. There had been a great deal of talk recently respecting the payment of illicit commissions, a subject on which the Lord Chief Justice had been making severe comments. He was therefore happy to assure them that no illicit commission by one shilling had ever been paid by their directors to obtain contracts. The contractor had promised that their new works should be completed so that they might be opened in July. He afterwards warmly recognised the services of the managing director and the staff generally.

The report was adopted.

India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

The thirty-fifth ordinary general meeting was held last Thursday at Cannon Street Hotel, the Hon. Henry Marsham presiding.

The Chairman, in moving the adoption of the report and the payment of a final dividend of 7½ per cent., or 15s. per share (making 10 per cent. for the year), said that their works, except the cable department, had been well employed, and they had been over pressed, fortunately, in some of the more recent and rapidly-developing branches. Steps were being taken to meet the demand for production in these special lines. With regard to cable work, they were prepared to undertake any amount of it, but there had lately been none open to tender. The seas were occupied by submarine cables, and those that had been laid had longer "lives" than was originally contemplated, so that renewals were not required frequently. The high prices of some of the raw materials had been severely felt by all India-rubber manufacturers, and although the board were not able to arrange with the competitors of their French works to make a *pro rata* advance in selling prices, the English manufacturers had recognised the necessity of an advance, which had been in operation during the greater part of 1898. The raw material showed no sign of an immediate fall, but the directors did not anticipate that they would have to make any further advance in their selling prices. The company's cable vessels had had moderate employment during the past year. The steamship *Silvertown* was engaged in completing the laying of a trans-Atlantic cable, on which that vessel, and the steam-

ship *Dacia*, were employed in 1897. The work was carried out by their staff, under the superior direction of the charterers. All the operations in which their vessels were engaged were successful, and proved the perfect efficiency of their men and ships. Their steamship *Dacia* had made one voyage, and the *Buccaneer* had just returned from Cuba, where she was engaged by the Cuba Submarine Telegraph Company to reinstate some of that company's cables which suffered during the late Hispanc-American war. The company were doing a fair business in the manufacture of electric machinery, and had just delivered to the Royal Arsenal at Woolwich one of the largest, if not the largest, single current dynamos manufactured in Great Britain. This business, which they started about 22 years ago, had definitely assumed the nature of a healthy manufacturing enterprise—that was, a steady business in which the risk was small.

Mr. S. William Silver seconded the motion.

Mr. Lamont asked if the chairman had not any comment to make on the auditor's certificate, in which the "debentures and shares in other companies," and the "debts owing to the company," were referred to in a way that was rather terrifying. The certificate stated that these were amply provided for by the reserve fund. He should hope that they were, seeing that the fund stood at £450,000. The wording of the auditor's report was calculated to excite a considerable amount of misapprehension in the minds of the shareholders, and he thought that it would be satisfactory to have an assurance from the chairman that there was no item of any magnitude in jeopardy.

The Chairman replied that the question of the auditor's certificate was brought to their attention last year, and he then said that the wording of it was not exactly to the liking of the board. However, the auditors had thought fit to adhere to the same wording on the present occasion.

Mr. Cochran asked for some explanation as to the way in which the debentures and shares were valued, and for an assurance that the debts carried over were not old ones.

The Chairman stated that the valuation was made by the board, and that they were of opinion that it was a proper one. The debts were not of long standing, and already a large proportion of them had been liquidated.

The resolution was carried unanimously.

The Hove Electric Lighting Company, Limited.

The seventh report of the directors, to be presented at the annual general meeting of the shareholders at the City Terminus Hotel, Cannon Street, in the City of London, on Wednesday, March 8th, 1899, at 12 o'clock noon precisely, states that the units sold to customers during the past year were 350,354 as compared with 268,243 for the previous 12 months, while the gross revenue amounted to £9,480 7s. 1d. as against £7,269 11s. 4d. in 1897, an increase of £2,210 15s. 9d. On the other side of the account, the gross expenditure of £4,390 8s. 11s. is an increase of only £723 7s. 3d. over the expenditure of the previous year. The net result is a profit for the year of £5,089 18s. 2d., an increase of £1,486 8s. 6d. over the profits for the year 1897. In congratulating the shareholders upon this excellent result, the directors would point out that the reduction in price of current, mentioned in last year's report, has been amply justified, as it has had the effect of increasing the number of customers and the demand for current. The directors have no doubt that the most profitable policy which can be adopted by the company will be to further reduce the price, but until the station has been enlarged, and ample provision made for dealing with a further greatly increased demand for current, it will, in the opinion of the board, be inadvisable to make any further reductions. The number of lamps and motors connected to the company's system at December 31st last was equivalent to 36,967 8-candle-power lamps, and the number of houses connected to 513, as compared to 27,777 lamps and 397 houses at December 31st, 1897. To the net revenue of £5,089 18s. 2d. has to be added the sum of £214 13s. 2d. balance brought forward from last year, making a total amount of £5,304 11s. 4d. After deducting debenture interest paid and accrued, and the interim dividend paid in October last, and providing for income-tax, there remains a net balance of £3,264 15s. 3d. at the credit of the revenue account. The directors propose to write the sum of £247 17s. off the preliminary expenses account, to place £1,000 to the reserve fund, to declare a dividend (payable on April 15th next) at the rate of 8 per cent. per annum for the half-year on the share capital, making, with the interim dividend, 6½ per cent. for the year, and to carry the balance, £400 1s. 5d. forward. The reserve fund, by the addition now proposed to be made, will stand at £5,287 17s., and a further sum of £191 3s. 1d. has been added to the depreciation and maintenance reserve account, which now stands at £1,105 13s. 1d. Since the date of the last report the directors have issued 1,000 of the new £5 shares at the price of £7 each, the premiums being added to the reserve fund. They have also issued £700 of 4 per cent. debenture stock, making the total debenture charge at the present date £25,000. During the year now past, the expenditure on capital account was £10,641, bringing up the total capital expenditure at December 31st last to £77,450 12s. 2d. Two new steam dynamos of 350 and 40 H.P. respectively, besides an additional Babcock and Wilcox boiler, have been placed in the generating station. Over £4,500 has been expended on new mains and strengthening the existing feeders and mains, and £1,120 on additional meters and demand indicators. The continual increase in the company's business has forced upon the directors the consideration of the extension of the lighting station, and additions to the generating plant therein. To meet the cost of these and of further extensions to the company's mains, it will be necessary to raise additional capital. The directors propose, therefore, to issue the remaining 1,000 £5 shares, bringing the total subscribed capital of the company up to £50,000, and such shares are offered to the members *pro rata* according to their holding in the company at the price of £7 10s. per share. The notice and necessary forms of application accompany this report. It is further proposed that the nominal share capital of the company shall be increased to £100,000 by the creation of 10,000 additional shares of £5 each, the new shares to be issued as and when required. The necessary resolution, set out in the accompanying notice, will be submitted to the meeting. The directors regret to report the death of Mr. Robert Payne, F.C.A., who has been auditor of the company since its commencement. They have appointed as auditors of the company for last year Messrs. J. H. Duncan & Co., chartered accountants, 39, Coleman Street, who now offer themselves for re-election for the current year. In accordance with the articles of association, Mr. Harold A. Hoare retires from the board of directors by rotation, but offers himself for re-election.

The Notting Hill Electric Lighting Company, Limited.

The directors' report states that the expenditure on capital account at the date of the last balance-sheet stood at £113,184 5s. 4d. and during the past year a further sum of £14,819 14s. has been expended; £9,248 0s. 5d. on new mains and machinery, and £4,060 16s. 7d. on the purchase of additional freehold property, bringing the total expenditure up to £128,003 19s. 4d., being £2,003 19s. 4d. in excess of the capital received. Further issues of first mortgage debentures amounting to £21,000 were made during the year at premiums aggregating, after deducting stamps and petty expenses, £1,308 13s. 9d. The directors have dealt with these premiums as follows: £973 16s. 7d. has been written off the balance of the expenditure not represented by visible assets, bringing this item down from £5,205 5s. 4d. at which it originally stood to £1,000, and the balance of £324 17s. 2d. has been placed to the credit of renewal and reserve fund. The reduction in the charge for current had but a slight effect upon the revenue, and the policy of the directors in encouraging the higher voltage has been so far successful that already more than two-thirds of the consumers are supplied at 200 volts. When this conversion is completed the saving in the cost of distribution will be considerable. During the past year this company, in common with other metropolitan companies, was seriously threatened with competition, and the directors, besides joining in opposing Bills before the Parliamentary Committees, adopted a policy of strengthening the position of the company in the district by extensions of mains, so that should Parliament grant a competing order they might be able to protect the interests of the shareholders. The buildings were extended by the purchase of the freehold house, 140, High Street, Notting Hill, so as to provide a frontage on the main thoroughfare, and thereby bring the company and its officers into closer touch with the inhabitants of the district. The present central station being fully equipped, and in view of the increased demand for current, the directors were considering the advisability of extending their works on the north side of the station on the freehold land which was secured at the outset of the undertaking with this object. The Kensington and Knightsbridge Electric Lighting Company, Limited, were also desirous of increasing their works, and the two companies met and decided to establish a joint station at some convenient position where current could be produced at a minimum of cost, and a joint Bill promoted by the two companies with that object is now before Parliament. The Vestry of Kensington on the other hand, anxious to have the streets and public buildings of the parish lighted by electricity, also deposited a Bill in Parliament asking for powers to erect works with that object, this Bill would have enabled them to enter into competition with the existing companies. After long negotiation the directors of the two companies succeeding in effecting an agreement with the Kensington Vestry, in accordance with which that body agreed to withdraw its Bill and petition in favour of the "Kensington and Notting Hill Electric Lighting Bill," the two companies agreeing, each in its own area, to supply current for the purpose of street lighting, and for the use of the Vestry's buildings, on terms which are satisfactory to both parties. After the business to be transacted at the ordinary general meeting is completed an extraordinary general meeting will be held, to confirm the resolution passed by the shareholders on February 2nd, approving of the "Kensington and Notting Hill Electric Lighting Bill" mentioned above. This agreement will be explained to the shareholders, and the directors are satisfied that the result will be to strengthen the present position and increase the future prosperity of the company. Of the £7,251 13s. 7d. profit, the directors have set aside £825 2s. 10d. for depreciation and reserve fund, making together with the balance of premiums £1,160, and bringing the total amount up to £4,500. After paying the debenture interest amounting to £685 16s. 8d., and 6 per cent. on the preference shares amounting to £1,738 16s. 10d., there is a balance of £3,933 18s. 11d., out of which the directors recommend that a dividend at the rate of 6 per cent. per annum, less tax, be declared on the ordinary shares. An interim dividend at this rate was paid on June 30th, and the balance when declared will be paid forthwith.

Chelsea Electricity Supply Company, Limited.

The directors' report to be submitted at the ordinary meeting to be held on Monday next states that in November, 1898, an issue of £40,000 debenture stock was made at the price of 108½ per cent. This issue was fully paid up in January, and a Stock Exchange quotation has been applied for. The balance of premium received in 1898, after deducting expenses of issue and certain special law and incidental expenses, has been carried, as on previous occasions, to the reserve fund. The total of the reserve fund now stands at £46,818 3s. 4d. The whole of the authorised share capital (£200,000)

has now been issued, and debenture stock to the amount of £100,000 has also been issued. It becomes necessary, therefore, to take powers to increase the authorised share capital, so that future issues may be made as required by the progress of the business. The proposed alteration of the articles of association of the company in regard to directors' fees does not increase the amount now payable under Article 70 until a dividend of more than 6 per cent. is paid on the ordinary share capital. Early in last year the shareholders approved a draft Bill for the compulsory purchase of certain properties required for the purposes of the business. That Bill was successfully carried through Parliament, the Chelsea Company being the first to obtain an Act for powers for compulsory purchase of land within the area of supply. The result of the Act is to enable the company to acquire at reasonable cost such lands and premises as it requires. The sum of £2,500 has been added to the renewals and depreciation fund, out of the net revenue. After deducting this amount, and after payment of interest on debenture stock (£2,822 15s. 10d.), there remains a balance of £12,923 3s. 6d. The directors recommend that this balance shall be applied as under:—

	£	s.	d.
Interim dividend of 6 per cent. per annum on the preference shares for the half-year to June 30th, 1898 (paid July 1st, 1898)	900	0	0
Interim dividend of 5 per cent. per annum on the ordinary shares for the half-year to June 30th, 1898 (paid July 1st, 1898)	4,250	0	0
Dividend of 6 per cent. per annum on the preference shares for the half-year to December 31st, 1898 ...	900	0	0
Dividend of 7 per cent. per annum on the ordinary shares for the half-year to December 31st, 1898, making a total dividend of 6 per cent. for the year	5,950	0	0
Balance to be carried forward to next account ...	923	3	6
	£12,923	3	6

The number of lamps connected on December 31st, 1898, was 112,587, an addition of 15,949 during the year.

At an extraordinary meeting to be held at the conclusion of the ordinary meeting, proposals to increase the capital and the directors' remuneration will be submitted.

Kensington and Knightsbridge Electric Lighting Company, Limited.

Mr. Granville R. Ryder presided on Wednesday last week over the twelfth ordinary general meeting of the above company held at No. 1, George Street, S.W., and in moving the adoption of the report said it was satisfactory to know that they had been able to earn a substantial dividend of 10 per cent. in a year, which was not one of special activity in their district with regard to electricity, and in which the progressive increases of previous years had not been maintained, but the dividend had been paid without straining their resources and without diminishing the provision made for various things which it was prudent for them to provide for. With regard to the number of houses and shops connected with the system during the year they had increased from 1,620 to 1,851, an increase of 231. The increase of 1897, as against 1896, was 295. He did not think, however, the matter was really of very great importance, because the number of lamps had increased by 18,200 in the year 1898, as against under 18,000 in 1897, from which they might infer that houses which already had taken the light took more, or that larger shops on the average had taken the light The number of units sold in 1898 were 2,081,074, and in 1897 it was 1,598,362, which represented an increase for 1898 of 182,711 units. The increase in 1897 over 1896 was a very much larger one, it being 383,633 units. But still there was not much difficulty in accounting for that. The year 1897 was the Jubilee year, and in that year there was a very great deal of private and public lighting. Another thing was that there had been a great absence of fogs that year—in fact, they were only blessed with one fog in November, and that disappeared at 12 o'clock. The cost of production in 1898 was £31,897, and in 1897 £29,270, an increase of £2,427. Against that increase had to be put the increase of units generated and sold. During 1898 the gross receipts amounted to £46,331, and in 1897 to £43,910, an increase of £2,600; but the amount to revenue account was £6,300 against £7,263. That on the face of it did not look well, but it was not difficult to account for. In the first place, the interim dividend was 5 per cent. against 4 per cent., and consequently the company had the use of less money in its coffers, although the shareholders had it in their pockets. That made a difference of £750. Then rates increased, as usual, by £400; they had put £300 more to the renewal account, and the insurance and salaries had also increased. Last but not least, there was a large increase in the cost of coal, viz, £6,586 as against £5,267, a difference of £1,115. That showed that there was not much in the decrease. Then there was another point—the average price paid them by their consumers. The average amount paid to them in 1897 was about 5d. and a fraction per unit, but in 1898 it was a fraction less than 5d., making altogether a difference of about ¼d. per unit. That was not a large sum, but on 2,000,000 units it came to £2,000. They did not reduce the rate if they could help it, but they lived in a considerable atmosphere of competition. It was not, however, competition from the vestries or other companies, but the competition of large establishments. If it did not pay a large establishment to come to them for their light they made it themselves, and so the company had to be very careful with regard to the charges.

Sir Fredk. Bramwell seconded the motion, which was carried.

The Chairman then moved the confirmation of a resolution approving of the company's Bill now before Parliament, promoted in conjunction with the Notting Hill Electric Lighting Company. He said the board had had a meeting with the vestry, and had arrived at a very satisfactory conclusion, and he believed the Bill would be unopposed.

Sir Fredk. Bramwell seconded the motion, which was carried.

The Imperial Tramways Company.

References were made to the extension of electric traction near London and in other parts of the country at the ordinary general meeting of the shareholders of the Imperial Tramways Company held at Bristol on Tuesday afternoon. Mr. George White presided, and in his address on the various departments of the company's work, alluded to the report of the London United Tramways (in which the Imperial Company has an interest) as showing remarkable vitality and enterprise. That company, working with animal power, was able to give its shareholders 10 per cent, and with powers to convert eight miles of existing lines into electric tramways, the prospect was very bright. He had great hopes that the whole of the works would be in operation in 12 months. In addition, powers were being sought to extend the line from Brentford through Twickenham, Teddington, and Hampton Wick, to Hampton Court. That scheme would prove of immense value to London people, and it could not be doubted that the Light Railway Commissioners would grant the necessary powers. If so, they would have a route of about 35 miles of electric lines in these attractive suburbs of London, West. The overcrowding question was one of London's problems, and he ventured to say they were doing much to assist in solving that question by carrying out these electric railways. Then, again, they knew the valley of the Thames and Hampton Court was a happy hunting ground of the London holiday seeker. What an advantage it would be for the London man to book at the Mansion House by the new Central London Railway for Shepherd's Bush, from whence the company for which he was now speaking could take him by electric cars through Chiswick, Brentford, and Twickenham to Hampton Court direct. The line to Hounslow, and also to Uxbridge, *vid* Hanwell and Southall, would not only prove a great convenience to the public, but would certainly add to the dividend-earning capacity of the company. An idea of the scope for development which the London United Company had was shown by the resolution of the Acton Urban Council last week requesting the company to tender for the supply of electricity for lighting their district. Turning to other districts, the chairman spoke of the success of the Middlesbrough, Stockton, and Thornaby electric lines, which, since their opening on July 16th last, had carried nearly four millions of passengers and earned £21,092 up to December 31st. Fares were low and earnings per mile not high, but on the first half a dividend of 7 per cent. on the outlay had been earned. At the request of the local authorities the company was promoting about six miles of extensions of their electric tramways under the Light Railways Act. They were in agreement with the authorities who thoroughly recognised the great advantages which would accrue to their residential suburbs in linking them in this manner with the centres of industry. They hoped to obtain the necessary powers in the next few months, and would lose no time in building the line. In his opinion there was a fair opening in and around the three boroughs for the profitable outlay of as much capital as they had already spent there, and if the local authorities showed the same business spirit, there would be no lack of enterprise on the part of the company. Their Darlington undertaking was a small "one horse" concern. The Town Council of Darlington had approached them to see if something could not be done as in the neighbourhood of Stockton and Middlesbrough. Their company explained they were quite ready to apply to the Light Railway Commissioners for the requisite authority to lay down a system of eight miles of electric lines in and around Darlington, and as a result of negotiations, the Council had approved of the company's proposal. Surveys were being made for an electric system. The chairman expressed their obligations to Mr. Clifton Robinson, their managing director and engineer, and in conclusion, said the result of their work was that out of their available surplus they paid the debenture interest, and also 6 per cent. on their preference shares, and recommended 7½ per cent. dividend on the new ordinary capital of the company. The report was adopted, and dividends approved.

Newcastle Electric Supply Company.

The eleventh ordinary general meeting of the Newcastle-upon-Tyne Electric Supply Company, Limited, was held last week at the company's office, New Bridge Street.

The Chairman (Alderman T. G. Gibson) presided, and in moving the adoption of the report and balance-sheet, said the business of the company had increased very satisfactorily during the past year. Their output in units was 803,789, against 660,960 in 1897, and their total profit for the year was £6,020. They had made very liberal allowances for depreciation of mains, plant and materials. The directors recommended that a dividend be paid of 4½ per cent. for the last half-year, making in all 8 per cent. for the year. That would leave a sum of £1,994 in hand, of which they proposed to place £1,000 to reserve and depreciation, carrying forward £994. The capital of the company had been increased by the issue of a number of new shares, which was necessary in order to put the company in a position to meet the increased demand for energy. The sum had been mainly expended in the provision of new generating plant, capable of turning out 10,000 volts. The total cable mileage was now 23 miles, and during the year they

had laid down 3¾ miles. Their total number of boxes was 675. He was pleased to say that the directors, in view of the satisfactory state of the accounts, had resolved to relinquish the rent charge for transformers and apparatus, which would relieve consumers to the extent of £600 per annum. Referring to the Newcastle Corporation Bill, in which power was sought by the Corporation to supply electricity, he said that seemed, at first blush, as if it amounted to an encroachment upon the rights of the company, and the directors would take every step in their power to maintain the rights and interests of the company.

The motion for the adoption of the report was seconded and carried.

A Shareholder complimented the directors upon the fact that, of the £1,965 increased income, only about £700 had been absorbed by increased cost, leaving £1,264 for increased profits.

A dividend of 4½ per cent. for the half-year ended December 31st was declared, making 8 per cent. for the year.

Charing Cross and Strand Electricity Supply Corporation, Limited.

Mr. W. F. Fladgate, chairman, presided on Monday at the offices, Maiden Lane, over the annual meeting of the above corporation, and in moving the adoption of the report, said the directors felt that they put before the shareholders a report showing satisfactory progress, and of which they did not think the shareholders need feel ashamed. As regarded the plant, the directors never had any hesitation in spending what was necessary to keep it in the highest state of efficiency, as it was the most important thing for them to deal with. At Lambeth they had an exceedingly extensive and carefully constructed installation, and with a view to decreasing the expenses of that installation, they had proceeded to sink a well, and so far as they have gone they believed their anticipation would meet with success. When they last met he told them that certain boilers had been put in at the Lambeth station, but which were not working satisfactorily, and that there was a chance of litigation between them and the manufacturers. He was glad to say that the manufacturers had met them in a handsome manner, and acting on the verdict of an expert, they had agreed to take those boilers back. So far the boilers were still working, and consequently they had not had the decrease in expense anticipated. However, the new boilers were nearly ready, and they hoped soon to get them installed. The report told them that provisional orders had been obtained for the southern areas of Holborn and St. Giles. At present these areas had been unproductive, but they had laid down 7½ miles of mains, and they had no reason to doubt but that when they were in a position to work the districts they would be productive of very great gain to the Corporation. They were pushing forward, and had applied for a provisional order for the City of London, and had obtained a memorial signed by no less than 3,000 persons. These included 29 leading banks, 81 insurance offices, and 92 newspaper offices, which showed that many people in the City thought there should be competition in the City, and if they obtained powers from the Board of Trade they had no hesitation in saying they thought it would be an exceedingly good thing for them. During the past year they had added 26,694 to their supply in the whole of their districts, which meant an increase in their customers of 374 persons, which was exceedingly satisfactory. It was also satisfactory to note that no less than 13,000 of the increase in lamps came from their old district of St. Martin's, while the Strand district had taken the bulk of the remainder, and as he said, the new districts, for all practical purposes, had taken none yet, yet they were considering applications for 20,000 more lamps, and hoped to supply them shortly. Eighteen and a half miles of mains had been added. The output now amounted to 3,246,000 units, and it might be interesting for him to point out that whereas in 1891 their output was the smallest of the metropolitan companies, now they came fifth out of the 13, which showed what progress the company had made, notwithstanding competition, and notwithstanding the efforts of other companies to get that custom which they hoped always to keep for themselves. The increase in the output had caused an extension of their buildings, and they were now erecting a new sub-station on a site they had obtained in Drury Lane on a lease of 999 years. In that sub-station would be a battery of accumulators, and with the station at Lambeth and the one in Maiden Lane, they would be in a position to supply 250,000 lamps, of which they were now supplying 134,000. Their net earnings amounted to £21,377 2s. 6d. as against £18,907. They had heard from various sources that last year was not a particularly good year for lighting companies, but they did not feel that they had any great cause to complain of the results which they now brought before the shareholders, for they were enabled, without straining their resources in any way, to recommend a dividend at the rate of 8 per cent. per annum, and to carry forward £3,292. Proceeding to deal with the question of the unissued debentures, the chairman said they, by an arrangement with the bankers, obtained £57,500, at a minimum interest of 3 per cent., and so had got the money they wanted at a cheaper rate than by issuing more debentures. Their powers at present enabled them to issue £150,000 debentures, of which £70,000 had been issued. The chairman then went through the various accounts, and dealing with the revenue account said that the cost of coals had engaged their serious consideration, for at present they were not at all satisfied. They had also got into trouble over their smoke, and their engineer was doing all he possibly could to stop it. At present there was no destructor in the market which was of use, but the engineer believed one would be brought out, and they would not hesitate to use it if it was of use. Share premiums of £9,600 had been carried to reserve, and if they added that sum to the depreciation account, they would see that their reserve amounted to the respectable total of £29,609. Their line of pressure, as they would see from the chart presented with the report, compared most favourably with the other companies, and their price was the lowest in the market. They received for their light 4·41d., and the only other company supplying under 5d. in the metropolis was the St. James's Company, which had come down to 4·78d. They were asking the shareholders to vote for an increase of £100,000 in the capital, which they proposed to issue at a considerable premium. With that additional capital he believed they would be enabled to do the whole of the work necessary for supplying the new districts. They were in an exceedingly favourable position to supply the City if they got the necessary powers, but that would require a large increase of capital, and they would do nothing till they had consulted the shareholders. In conclusion, the chairman referred in eulogistic terms to the admirable work which had been performed by the staff.

Mr. G. H. B. Glasier seconded the motion, which was carried.

A resolution was next proposed, giving the board power to issue 20,000 new ordinary shares of £5 each, and the Chairman, in moving it, said that he considered that it was necessary for the future success of electric light companies that they should have large and adequate areas to work in.

The resolution was seconded by Mr. Glasier and agreed to.

The Brush Electrical Engineering Company, Limited.

In their interim report to the shareholders for the half-year ended December 31st, 1898, the directors say that the works at Loughborough, including the new shops completed, have been well employed, and the volume of orders received during the half-year has been satisfactory. The further extensions at the company's works at Loughborough, rendered necessary by the increasing demand for plant and rolling stock for electric traction purposes, are making satisfactory progress. Various important contracts in connection with electric lighting and electric traction undertakings have been secured and are in hand. An interim dividend for the half-year at the rate of 6 per cent. per annum has been declared on the company's preference shares.

Stock Exchange Notices.—The Stock Exchange Committee have ordered the undermentioned securities to be quoted in the Official List:—Edison & Swan United Electric Light Company, Limited—further issue of £150,000 4 per cent. debenture stock. New General Traction Company, Limited—4,000 vendors' 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 1 to 4,000, and 6,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 4,001 to 10,000.

The Direct Spanish Telegraph Company, Limited.—The board have decided to pay, in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, an interim dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended December 31st, 1898, and payable on April 1st next.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended December 31st last, and payable on the 24th inst. The transfer books of this company will be closed from March 17th to the 23rd, both days inclusive.

Metropolitan Electric Supply Company.—The board announces a final dividend of 5s. per share, making 10s. for the year.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending February 25th, 1899, were £207 4s. 3d.; aggregate to date, £1,267 5s. 1d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending February 24th, 1899, were £2,589 17s. 8d.; corresponding period, 1898, £2,290 8s. 11d.; increase, £299 8s. 9d.

The Dover Corporation Electric Tramways.—The receipts for the week ending February 25th, 1899, were £142 9s. 1d.; week ending February 26th, 1898, £100 12s. 10d.; increase, £41 16s. 3d. Total receipts to date, 1899, £1,143 3s. 5d.; corresponding period, 1898, £848 10s. 9d.; increase, £294 12s. 8d. Miles of track open week ending February 25th, 1899, 3; week ending February 26th, 1898, 3. Car miles run week ending February 25th, 1899, 4,313; week ending February 26th, 1898, 2,739. Number of cars, week ending February 25th, 1899, 11; week ending February 26th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, February 24th, 1899, were as follows:—D. U. T. Co., horse cars, £1,704 11s. 4d.; ditto, electric cars, £956 11s. 1d.; D. S. D. Co., electric cars, £648 10s. 6d.; total, £3,309 13s.; corresponding week last year—D. U. T. Co., horse cars, £2,327 12s. 1d.; ditto, electric cars, £98 10s. 1d.; D. S. D. Co., electric cars, £350 5s. 2d.; total, £2,776 7s. 4d.; increase, £533 5s. 8d.; aggregate to date, £25,282 19s. 1d.; ditto last year, £24,468 9s. 11d.; increase to date, £814 9s. 9d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending February 22nd, 1899, were £324; total receipts to date, 1899, from June 29th, 1898, £9,126. Miles of track open, 3½. Car miles run, 5,330. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending February 26th, 1899, amounted to £1,280; corresponding week last year £1,300; decrease, £20.

The South Staffordshire Tramways Company.—The receipts for week ending February 24th, 1899, were £624 8s. 2d.; aggregate receipts for eight weeks, £4,714 11s. 8d.; week ending February 25th, 1898, £551 0s. 4d.; aggregate receipts for eight weeks, £4,696 0s. 6d.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Feb. 22nd.	Closing Quotation, March 1st.	Business done during week ended March 1st, 1899. Highest.	Lowest.
124,400l	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	101	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	87 — 92	87 — 92	...	...
905,560l	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	67 — 69	67 — 69	...	...
3,047,220l	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	119 —120	119 — 120	119¾	119
3,047,220l	Do. do. Deferred...	Stock	...	...	18s. %	14½— 15	14½— 15	15	14⅝
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	...	16 — 16½	16 — 16½	16¼	16⅛
75,000l	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	180 —190	190 —200	...	...
1,332,523l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106⅛	105¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	...	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	7 %	...	9½— 10⅛	9½— 10⅛	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	17½— 18½	17½— 18½	18⅜	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000l	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	...	104 —107%	104 —107%	...	...
60,710l	Direct United States Cable	20	2½ %	...	...	12 — 12½	12¼— 12⅜	12⅝	12 5/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	103 —106	104⅜	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	179 —184	180 —185	183	181
1,295,000	Do. 3½ % Pref. Stock	100	...	...	...	104 —107	104 —107	106½	104
500,000	Do. Prov. Certs., all paid	...	...	...	...	104 —107	104 —107	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	99 —102	99 —102	...	...
1,432,268l	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	126 —130	126 —130	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	17¾— 18¼	18 — 18½	18⅝	18¼
16,200l	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400l	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000l	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	125 —129	125 —129	...	...
35,100l	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500l	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000l	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000l	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	...	12¾— 13¼	12¾— 13¼	13	12⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17 — 17½	17 — 17½	17¼	17
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	29½— 30½	30 — 31	30	...
150,000l	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	...	101 —104	98 —102xd	...	...
97,800	Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	99 —102	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	58 — 61	58 — 61	...	...
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	107 —110 xd	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	6 %	6 %	5⅜— 6	5⅜— 5⅝xd	5 13/16	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16 xd	14½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16 xd	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5¾	5½— 5½xd	5⅝	5 5/16
1,329,471l	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101⅜	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝— ¾	⅝— ¾	...	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	6½— 7½	6⅞	6⅝
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	139 —144	141¾	141
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,733l	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000l	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	97 —100 xd	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	107 —110	...	...
88,321	West India and Panama Telegraph	10	1 %	¾%	...	1⅝— 2	1⅞— 2⅛	2	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 11	10 13/16	10⅝
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	9 — 10	...	...
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	105 —108	...	...
158,100l	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11½— 12½	11½— 12½	12	11⅞
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8½— 9½	8½— 9½	...	...
60,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	114 —116	114 —116	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	7 %	10 %	6 %	18½— 19½	19½— 20½	20⅜	19¼
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	18½— 19½	19 — 20	19⅝	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	16	15⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	124 —129	124 —129	126	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	...	12½— 13½	12½— 13½	13	12⅜
10,000	Do. do. do. Nos. 30,001 to 40,000 ...	10	...	...	...	12½— 13½	12½— 13½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	14½— 15½	14½— 15½	15⅝	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5¾	5¼— 5¾	...	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	4 %	...	9 — 10	9 — 10	9½	9⅜
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9½— 10½	9½— 10½	9⅞	9 11/16
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3⅞	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	17 — 18	16½— 17½	17⅞	17 11/16
22,500	Do. Nos. 62,501 to 85,000, £7 paid ...	10	...	...	...	13½— 14½	13½— 14½	14 13/16	...
220,000l	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	118 —121	119	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	17½— 18½	16½— 17½	17½	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16½— 17½	17 7/16	16⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10 xd	9⅜	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	3½— 3¾	3½— 3¾	3⅝	3 5/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15½— 16½	15½— 16½xd	15⅝	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Feb. 22nd.	Closing Quotation Mar. 1st.	Business done during week ended Mar. 1st, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3 — 3½	3 — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16½— 17½	16½— 17½	17⅜	17½
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¼— 13⅜	13¼— 13⅜	13½	...
100,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	121 —123	125 —127	126	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	2 — 2⅛	2 1/16	2
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜xd	2⅜	2¼
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	111 —115	110 —114 xd	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	104	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	12½— 13½	12½— 13½	13	12⅝
90,000	Do. do Ord. shares, Nos. 1 to 22,500 £5 pd.	Stock	...	...	...	113 —116	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10⅛	9⅞
178,303	Do. do. do. £8 paid	10	...	...	...	7⅜— 8¼	7⅜— 8¼	8	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3½— 4	3½— 4	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4 — 4½	4½— 4⅝	...	...
630,000*l*	City and South London Railway	Stock	1 9/16%	1⅞%	2⅛%	71 — 73	71 — 73	72	71
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	5 — 5½	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¼— 3⅜	3¼— 3⅜	3⅜	3½
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	98 — 101	98 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2¼— 2⅜	2¼— 2⅜xd	2⅜	2⅜
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5 xd	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	97 — 99	98 —100	99¾	98
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2¼— 2½	2 5/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	3¼	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	104	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	3/16— 5/16	5/16— 7/16	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	½— ¾	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...†	10	7 %	7 %	...	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25½— 26½	26½— 27½	27	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	113 —116	113 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	23 — 24	22 — 23 xd	22⅞	22 7/16
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	105½	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅜%	3½%	3¼%	10 3/16— 10 5/16	9 15/16—10 1/16xd	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14½— 15½	14½— 15 xd	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	40 — 44	41½	40½
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	8¾— 9¼	9¼— 9¾	9¼	9⅛
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	109 —112	109 —112	110	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7¾—8¼. Debentures, 106—109. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 8/- to 10/-.
Smithfield Market Electric, 4—4½.
*T. Parker, £10 (fully paid), 15⅛.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, March 1st.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	23/-	23/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£26	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£30 10	£30 10	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	67/-	67/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 15	..
a „ Recovered .. .. per ton	£5 15	£5 15	..
a „ Lump .. .. .. per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	..	£65 to £130	..
c Brass (rolled metal 2' to 12') basis per lb.	8¼d.	8¼d.	..
c „ Tube (brazed) .. .. per lb.	10d.	10d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£79	£79	..
g „ Wire (basis price) .. per lb.	9¾d.	9¾d.	..
g „ Sheet .. .. .. per ton	£79	£79	..
g „ Rod .. .. .. per ton	£79	£79	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½	4/2	½d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	47/7½	47/9	1½d. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£9 5	£9 5	..
g Lead, English Ingot .. .. per ton	£15	£15	..
g „ „ Sheet .. .. per ton	£15	£15 10	10/- dec.
l Mica (uncut slabs 5" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	..	1/- to 1/4	..
p „ rolled bars & rods per lb.	..	1/- to 1/4	..
p „ r'l'd strip & sheet per lb.	..	From 1/2	..
o Platinum .. .. per oz.	£3 6 6	£3 6 6	..
p Silicium Bronze Wire .. .. per lb.	..	10d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£115	£115	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/6	1/6	..
p White Anti-friction Metals— "White Ant" brand .. per ton	..	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¼d.	6¼d.	¼d. inc.
j „ Flax, 6 or 8 lea... .. per lb.	4d.	4d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4¼d.	4¼d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£33 10	£31 10	£2 inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31	£31	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE PRODUCTION OF CHLORATES BY ELECTROLYSIS.

Some hitherto unpublished results dealing with the electrolysis of calcium chloride solutions obtained by F. Oettel confirm those recently published by Foerster and Bischoff. The smallness of the loss of reduction is ascribed to the formation on the cathode of the film (calcium hydrate), which acts as a diaphragm. The electrochemical activity of this film, however, appears to have nothing to do with its thickness, since excellent results have been obtained with a very thin membrane, whilst another 2 mm. thick was practically worthless. The production, and what is more important, the preservation of a good membrane requires much skill and experience.

The following table is given representing a normal run, during the electrolysis of a solution of calcium chloride (130—150 grm. per litre), to which a little milk of lime had been added to precipitate any magnesia present. The current density on both cathode and anode was 900 amperes per square metre; potential 3·8—4·0 volts, and temperature 75° C.:—

Time from commencement.	Current efficiency.	Water decomposition.	Reduction.
Hours.	Per cent.	Per cent.	Per cent.
¼	71·8	4·1	24·1
½	76·3	11·4	12·3
1	78·2	12·5	9·3
3	79·7	16·5	3·8
5	83·1	12·5	6·4
10	81·9	11·4	6·7
22	83·3	12·5	4·2

It will be seen that the current efficiency improves during the first few hours, and then remains nearly constant at about 80 per cent. The distribution of the remaining 20 per cent. between water decomposition and reduction, is, however, very variable. In a precisely similar experiment, the electrolyte only being changed, the following results were obtained after a 10 hours' run:—

	Per cent.
Current efficiency	79
Water decomposition	9
Reduction	12

These results being considered very favourable, an attempt was made to utilise them by (1) electrolying the Ca Cl to produce Ca (Cl O); (2), adding KCl to precipitate difficulty soluble KCl O and regenerate Ca Cl, and then continuing the process; a totally unexpected result was obtained. The presence of KCl in the solution caused the separation of thick crusts on the cathode which gradually broke away, and at the same time free chlorine (not HCl O) was evolved along with the hydrogen. The author considers that the character of the deposit on the cathode was such that it could not redissolve rapidly enough to fix the chlorine. The behaviour of the deposit on the cathode was very uncertain. At one time a very thin film was sufficient to prevent the evolution of any chlorine; whilst at another time the film would entirely disappear, and its place be taken by the above thick crusts: chlorine being at the same time evolved. An addition of more calcium hydrate sometimes temporarily improved matters; the amorphous crusts disappeared only to reappear after some time.

Crystals of calcium oxychloride in the form of hard long needles were frequently obtained from the electrolyte on colling, and the author considers that this substance plays an important part in the electrolysis. It is possible that the curious behaviour on the addition of KCl may be connected not with the formation, but with the solubility of the oxychloride in KCl, and that the cathode crusts are composed not of calcium hydrate, but of insoluble oxychloride.

The electrolysis of calcium chloride solutions is subject to many other disturbing influences. On one occasion some copper chloride which had formed on one of the copper conductors got detached and fell into the decomposing cell, where it was converted into copper oxide which then acted catalytically, decomposing the hypochlorite with liberation of oxygen. Many other substances, including the oxides of nickel, iron and lead, act in the same way, so that it is necessary to exercise caution in judging the process from the results of gas analysis. This is clearly shown by the results which were obtained when copper oxide was present:

	Current efficiency.	Water decomposition.	Reduction.
	Per cent.	Per cent.	Per cent.
Apparent	30·9	57·2	11·9
Real	73·3	14·7	12·0

The second, or true value, was obtained from the same data after determining and allowing for the oxygen which was evolved by the action of the copper oxide in the same time (3 mm.) when no current was passing through the cell.

From the results of his investigations the author considers that the electrolyte production of chlorates takes place by two different processes, which occasionally operate together.

(*a*) Production of chlorate through the hypochlorite. The products first obtained, viz., alkali and chlorine, form hypochlorite, which, by the further action of chlorine and partially also by direct electrolytic oxidation, is then converted into chlorate.

(*b*) Production of chlorate by the direct union of chlorine and oxygen whilst they are being simultaneoutly evolved at the anode.

In neutral solution (*a*) is the chief reaction; in strongly alkaline solutions (*b*) predominates; whilst in weak alkaline solutions the two reactions take place simultaneously, provided that the current density of the anode remains the same in all three cases.

During the electrolysis of calcium chloride solutions (*a*) is the principal reaction. Such solutions show a tendency to become slightly acid owing to the formation of free hypochlorous acid; whilst in the case of the alkali chlorides it depends on the position of the electrodes, and on the current strength whether the stationary condition is accompanied by the presence of a slight excess of free alkali or of free chlorine. The above is an abstract of a paper by F. Oettel in the *Zeitschrift für Elektrochemie*, 1898, V., (1), 1—5.

THE ELECTROLYSIS OF ZINC CHLORIDE SOLUTIONS.

Starting with the assumption that the deposition of spongy zinc is caused by the presence of precipitated zinc oxide on the cathode, F. Foerster and O. Günter have made some experiments which tend to confirm this view. The following is an abstract of their paper which appears in the *Zeitschrift für Elektrochemie*, 1898, V. (1), 16—23.

A zinc cathode was suspended in a perfectly neutral purified zinc chloride solution containing 54·6 grms. of zinc per litre, between two anodes of pure electrolytic zinc.

With a current density of 1·4 ampere per square dcm., a smooth compact deposit of zinc was obtained on the cathode for the first six or seven hours, but after 20 hours spongy zinc was being deposited, and the solution was turbid from the presence of suspended basic zinc chloride.

On filtering off the precipitate and inserting a new cathode a good deposit was obtained during the first few hours. The electrolyte then again became turbid, and, at the same time, the deposit showed signs of becoming spongy. Schnabel (*Handbuch der Metallhuttenkunde*, 2, 114) states that the formation of spongy zinc may be prevented by the addition of chlorine or bleaching powder to the solution. The authors, therefore, tried the method adopted by Mylius and Fromm for keeping a solution of zinc sulphate constantly acid. A small quantity of free chlorine was continually evolved in the cell from two small platinum anodes, which were connected with the positive pole of two accumulators, whilst the negative pole was attached to the large zinc plate, which thus served as cathode for both pairs of anodes. The formation of spongy zinc, however, could not be prevented in neutral solutions by this arrangement.

The oxygen of the air easily oxidises zinc in presence of zinc chloridem, and a certain quantity of the oxide formed is dissolved by the solution forming basic zinc chloride. Deposition of spongy zinc only occurs when the excess of oxide begins to render the electrolyte turbid, and if this precipitation is prevented by the periodic addition of hydrochloric acid, good deposits of zinc can be obtained. The authors, therefore, recommend that the electrolyte should contain a quantity of free hydrochloric acid corresponding to a $\frac{1}{20}$th — $\frac{1}{30}$th normal solution. The acid may be increased until it represents $\frac{1}{10}$th normal acid, but it should not be allowed to fall below $\frac{1}{200}$th — $\frac{1}{300}$th normal.

If this slightly acid electrolyte is used in conjunction with the arrangement for liberating free chlorine, still better deposits of zinc are obtained. When the solution contains 0·2 grm. of free chlorine per litre, the hydrogen evolved at the cathode does not remain sticking to the electrode long enough to impair the surface of the deposit.

Although the main body of the electrolyte remains slightly acid, it sometimes happens that bad (spongy) deposits of zinc are obtained. This is accounted for by the fact that the layer of electrolyte in contact with the cathode becomes deprived of its free acid, but this difficulty may be overcome by sufficiently agitating or circulating the electrolyte.

On substituting anodes of commercial zinc for the pure zinc anodes, the zinc deposited in the cathode was found to be entirely free from arsenic.

When a 40 per cent. boiling solution of zinc chloride is saturated with zinc oxide (the cadmium subsequently removed by treatment with pure zinc) electrolysed at 90° C., with insoluble (platinum) anodes, good deposits of zinc are obtained.

The quantity of zinc thus deposited when compared with the amount of copper deposited by the same current in a copper voltammeter was found to be in good agreement with Faraday's law. Ashcroft (Schnabel's *Handbuch der Metallhuttenkunde*, 2, 214·215), on electrolysing a similar solution, found that the zinc deposited in the first two hours was 49 per cent., during the next two hours 37 per cent., and during the third two hours 14 per cent. in excess of that required by Faraday's law, whilst in the last two hours the theoretical amount was deposited. The authors conclude by discussing the nature of spongy zinc and the effect of adding various oxidising and reducing agents to the electrolyte. The addition of 1 per cent. of a perfectly neutral solution of ammonium persulphate to a neutral solution of zinc chloride furnished good deposits of zinc on electrolysis, whilst on the addition of 0·025 per cent. of hydrogen peroxide, the formation of spongy zinc was observed after electrolysing 10 minutes.

THE K R LAW.

By W. MOON.

The publication of some figures in the Electrical Review of June 3rd, 1898, that throws some doubt on the accuracy of the K R law, has led me to inquire into this question.

Lord Kelvin gives the formula,

$$c_t = c\left(1 - 2\left(\varepsilon^{-\frac{\pi^2 t}{K\rho l^2}} - \varepsilon^{-4\frac{\pi^2 t}{K\rho l^2}} + \varepsilon^{-9\frac{\pi^2 t}{K\rho l^2}}, \&c.\right)\right.$$

where c is the maximum current received, and "c_t" the current received at any time "t" after the current has been applied.

Whence on any two lines if $c_t = c_{t_1}$, where c and c_1 and t and t_1 are different, it follows that

$$\frac{\pi^2 t}{K\rho l^2} = \frac{\pi^2 t_1}{K_1 \rho_1 l_1^2},$$

where K is the capacity and ρ the resistance of unit length of line.

So that if s is the speed of working on one line, and s_1 that of the other,

$$s\ K\ \rho\ l^2 = s_1\ K_1\ \rho_1\ l_1^2,$$

or, taking any particular line where the speed is known as a standard—

$$s_1 = \frac{A}{K_1\ \rho_1\ l_1^2} = \frac{A}{K\ R}$$

The formula of Lord Kelvin does not, however, allow for the fact that several signals would be following each other at the same time in a long cable, and that each signal would be attenuated by one of an opposite sign following it. Lord Kelvin's formula does not, therefore, accurately give the speeds on cables. It does not, however, follow that his formula is much out, especially when the cables compared are not very different, as is the case, for instance, of the Atlantic cables.

Lord Kelvin first pointed out that the propagation of current through wires having capacity and resistance is given by Fourier's equation—

$$\frac{d^2 v}{d x^2} = K\ \rho\ \frac{d v}{d t}$$

Oliver Heaviside has given a general solution of this equation for reversals of current, and from the same equation Prof. Blakesley gives a solution for alternating currents on a line of infinite length. As Prof. Blakesley's formulæ are the best and most interesting, I shall discuss them and compare them with the K R law.

Blakesley's solution for the potential, v, at any time, "t," and place, "x," is

$$v = E\,\varepsilon^{-\sqrt{\frac{K\rho\pi}{T}}\,x} \sin\left(\frac{2\pi t}{T} - \sqrt{\frac{K\rho\pi}{T}}\,x\right) \qquad (1)$$

when T is the periodic time.

This equation and $c = -\frac{1}{\rho}\frac{d v}{d x}$ gives

$$c = \sqrt{\frac{E}{\frac{K\,2\pi}{\rho\,T}}}\,\varepsilon^{-\sqrt{\frac{K\rho\pi}{T}}\,x} \sin\left(\frac{2\pi t}{T} - \sqrt{\frac{K\rho\pi}{T}}\,x + \frac{\pi}{4}\right) \qquad (2)$$

Formula (1) represents a series of waves of potential, or static charges, travelling along a wire and decreasing in amplitude as they advance.

Formula (2) shows that the currents are in direction both forwards and backwards from the highest points of the positive parts of the waves to the lowest points of the negative portion of the waves. As the current from the rear of each crest is greater than that from the front of the crest of waves, the waves are continually moving forward as they decrease in amplitude.

A series of positive and negative charges following each other on a wire must tend rapidly to attenuate each other, each wave can but be a small fraction of the height of the one following it, and formulæ (1) and (2) shows this attenuation as proportional to

$$\varepsilon^{-\sqrt{\frac{K\rho\pi}{T}}\,.\,x}$$

Formulæ (1) and (2) give the wave length

$$= 2\sqrt{\frac{\pi\,T}{K\rho}},$$

from which the velocity of the wave is

$$2\sqrt{\frac{\pi}{K\rho\,T}} \qquad (3)$$

This wave velocity must not be confounded with the velocity of electricity. It must be less than the velocity of electricity. And the velocity of electricity is most probably less than that of magnetic induction, that is, than that of light.

The wave velocity given by formula (3) in a cable of $\frac{1}{3}$ mf and 3^{ω} per mile with a period of $\frac{1}{10}$ second

$$= 2\sqrt{\pi\ 10^7} = 11{,}200 \text{ miles per second.}$$

This is perhaps not an unlikely figure.

But in a wire of $\frac{1}{20}$ mf. and $\frac{1}{3}$ ohm per mile at 500 periods per second, the wave velocity

$$= 2\sqrt{\pi\ 20 \times 5 \times 500 \times 10^6} = 794{,}000,$$

that is, 4·3 times the velocity of light.

It is very unlikely that there could be any such wave velocity as this along a wire. And it is evident that any formula giving a wave velocity or wave length of alternating currents along a wire must include a function of the velocity of electricity to be accurate.

The only thing that is known for certainty of the velocity of electricity is that it must be proportional to the specific conductivity of the wire. This must be so, since in two wires of different specific resistances, r and r_1, and sections, d^2 and d_1^2, if

$$c = \frac{E\ d^2}{l\ r} = \frac{E\ d_1^2}{l\ r_1},$$

then as the same quantity of electricity must traverse both wires in the same time, it follows that the velocity in each wire will be inversely proportional to its area, that is, proportional to its specific conductivity.

But as the velocity of electricity can probably only be calculated from the wave velocity of alternations along a wire, the correct formula for the transmission of alternations can only be obtained with the assistance of a number of measurements of actual wave velocities.

Prof. Blakesley's formulæ give the current received on a line of length "l" earthed at the far end as

$$c = E\,2\sqrt{\frac{K\,2\pi}{\rho\,T}}\ \varepsilon^{-\sqrt{\frac{K\rho\pi}{T}}\,l} \sin\left(\frac{2\pi t}{T} - \sqrt{\frac{K\rho\pi}{T}}\,l + \frac{\pi}{4}\right). \qquad (4)$$

In this formula, if T is made very great to $K\ \rho\ l$, it reduces to

$$c = \frac{E\,2}{\sqrt{\frac{\rho\,T}{K\,2\pi}}} \sin\left(\frac{2\pi t}{T} + \frac{\pi}{4}\right).$$

But if formula (4) was correct it should, under these conditions, reduce to

$$c = \frac{E}{R} \sin \frac{2\pi t}{T}.$$

Despite of the want of accuracy of these formulæ, they are of considerable interest, for it is probable that when the correct formulæ have been determined from experiments, they will be found somewhat of the form that Prof. Blakesley gives. Moreover, within certain limits it is probable that they give results not very far from the truth, and it is interesting to compare them with the K R law.

Ignoring the phase, and taking mean E M.F. and current, formula (4) can be written—

$$c = E\,2\sqrt{\frac{K\,2\pi}{o\,T}}\ \varepsilon^{-\sqrt{\frac{K\rho\pi}{T}}\,l} \qquad (5)$$

from which—

$$\sqrt{\frac{\pi}{T}} = \frac{\log.\left(2^{\frac{3}{4}}\frac{E}{C}\sqrt{\frac{K}{\rho}}\right) + \log.\sqrt{\frac{\pi}{T}}}{\sqrt{K\rho l}} \quad (6)$$

And if $\frac{1}{T}$ is taken as a dot and its following interval in mirror-working, then the average letter might be taken as $\frac{3\cdot82}{T}$, and from this the words per minute, $W = \frac{\pi}{T}$, whence from 6—

$$W = \left\{\frac{\log\left(2^{\frac{3}{4}}\frac{E}{C}\sqrt{\frac{K}{\rho}}\right) + \log.\sqrt{W}}{\sqrt{K\rho l}}\right\}^2 \quad (7)$$

let $2^{\frac{3}{4}}\frac{E}{C}\sqrt{\frac{K}{\rho}} = a$ and $\sqrt{K\rho l} = B$

then

$$W = \left\{\frac{\log. A + \log.\frac{a + \log.\frac{a+}{B}}{B}}{B}\right\}^2 \quad (8)$$

a series that converges very rapidly.

If in a standard line $W = 21\cdot5$ $\rho = 3\cdot47$, $K = \cdot352 \times 10^{-6}$, $l = 2{,}563$, then

$$2^{\frac{3}{4}}\frac{E}{C} = 344 \times 10^6$$

and (7) becomes

$$W = \left\{\frac{\log\left(344 \times 10^6\sqrt{\frac{K}{\rho}}\right) + \log.\sqrt{W}}{\sqrt{K\rho l}}\right\}^2$$

from which the speed of working of any other lines can be calculated.

From these formulæ the speeds in the following table have been calculated, taking the 1882 cable as standard. But as I do not know the actual resistances and capacities of the cables given, I have had to guess at their value. The table will, however, suffice for purposes of illustration.

——	l	K Farads.	ρ Ohms.	W Blakesley.	W K R law.
1874	1,837	·43 × 10^{-6}	3·16	54	49
Standard 1882 ...	2,563	35 × 10^{-6}	3·47	21·5	21·5
Siemens 1894 ...	2,161	·412 × 10^{-6}	2·43	40	37
Tel. Constn. 1894	1·850	·378 × 10^{-6}	1·87	82	71
	2,161	10^{-6}	1·	46	37
	2,161	·412 × 10^{-6}	1·	112	85

From this table it will be noticed that an increase in the capacity results in a greater speed by the Blakesley than by the Kelvin formula.

Of course, it follows that no cables can be compared with each other by either formula unless they are worked by the same E.M.F. and fitted with similar instruments.

Equation (9) gives the current received as

$$c = \frac{E}{121\cdot5} \text{ in micro-amperes.}$$

It would be interesting to know how near this agrees with the actual currents received on the Atlantic cables.

It will be noticed that the Kelvin formula gives the ratio of the outer diameter of the insulator to that of the conductor as $\frac{D}{d} = 1\cdot65$ to obtain the maximum speed, but that the Blakesley formula does not—and probably in this respect the Kelvin formula is wrong.

(To be continued.)

THE KILDUCHEVSKY MEGA-TELEPHONE.

It will be remembered that last week Mr. A. R. Bennett in these columns and elsewhere flatly denied certain statements attributed to him regarding the Kilduchevsky transmitter. Although our correspondent did not choose to go beyond the retort courteous, we have been able, without his help, to arrive at a true elucidation of the matter in dispute. It appears that Mr. Bennett made a report on the Kilduchevsky transmitter, which is dated February 14th, 1898, but we find, on making a comparison between this and the paraphrase sent to us by the Kilduchevsky Syndicate that they are completely at variance. The different versions are as follows:—

Statement sent by the Syndicate.

"The Kilduchevsky transmitter was successfully tested in Russia on overhead lines, distances being up to two thousand miles (2,000), and in this country by A. R Bennett, on an artificial cable in which the essential electrical conditions of a modern telegraph cable were reproduced. The length of the cable was about two hundred miles (200) having a resistance of 594·48 ohms, and a static capacity of 59·73 microfarads, the product being 35,508, and with an ordinary double-pole receiver, the conversation of any description could be carried on without effort."

Statement from Mr Bennett's Report.

"The ordinary double-pole receiver hitherto used was now replaced by Mr. Kilduchevsky's receiver, in which the magnetism was reinforced by an extra set of coils and a local battery of six dry cells. This increased the loudness of transmission. The length of cable in circuit was now raised to about 195·6 miles, having a resistance of 594·48 ohms, and a static capacity of 59·73 microfarads, the product being 35,508. The loudness of transmission was again diminished and the articulation was no longer clear enough for the transaction of general business. The prices of stocks could be heard clearly enough, but the names of the stocks, when unfamiliar to the listener, could not be followed with certainty. Still, conversation of a simple kind between persons not unacquainted with the subject discussed was practicable."

It will be seen from the foregoing that Mr. Bennett has a legitimate grievance, but his complaint no less than our own is against the Kilduchevsky Mega-Telephone Syndicate, who sent us a garbled version of the report. We regret that we should have been the vehicle for publishing what are practically incorrect statements, and it is unfortunate that this rectification will not receive so wide a publicity as Mr. Bennett's letter.

With regard to the Kilduchevsky Mega-Telephone Syndicate we are fain to point out that it possesses more assurance than is usually found even among syndicates, for after sending us a revised version of what Mr. Bennett said, strong complaints were made by the syndicate because we applied the ordinary journalistic reservations to the alleged statements of results.

WIRING RULES.

The Institution of Electrical Engineers may congratulate itself on the important outcome of the two-nights' debate which the papers by Mr. Crompton, Mr. J. Pigg, and Mr. Wordingham gave rise to; and if the action of the Council in the duty which the resolution calls upon them to perform is in any way as enthusiastic and unanimous as the sense of the meeting which voted the resolution, there would seem to be, after all, some chance of the adoption of a common set of rules throughout the United Kingdom in the near future. Papers on the subject of wiring have been read on many occasions before the Institution, but these have mostly dealt with special hobbies of the authors—from patent fuses to patent conduits—and still the men who make rules continued to grind them out in ever-increasing number and variety, until the owners of hobbies got disgusted and the wiring contractors and manufacturers began to fear for the safety of their reason; for it is not as if the men who made rules had each one endeavoured to develop and cultivate existing rules of the class with which he had special connection; but like some orchid grower, they had one and all cross-fertilised other specimens with the view of producing a new and rare variety. In this they have been so successful, that neither Mr. Pigg—who set himself to make a collection of every variety—or Prof. Ayrton, who tried to classify them, have been able to find the law which connects them with systems they are intended to control, or to trace the missing link from which they all originated.

Meanwhile the most important thing that was noticed at the debate was the absence of Mr. Musgrave Heaphy. Was it that he had, like Achilles, retired into his tent? Or to jump a mere few thousand years, had he, like the Squire of Malwood, doubted the constancy of his followers? Or is he, perhaps, like Brer Rabbit, "lyin' low?"

No doubt time, the great revealer of all things, will satisfy our curiosity on this point also; but as Actæon was not present for his hounds to rend, it is exceedingly lucky that these docile animals were provided with another huntsman in the shape of Mr. Wordingham, upon whom, in the name of the enemies of all things municipal, they fell and did grievous damage. Not that Mr. Wordingham did not make a splendid fight, and laid low many of his aggressors, so that it is clear that many of his deeds of darkness will yet live and flourish; still individualism may be said to have scored a victory over collectivism which will put a check for a time to interference with the liberty of the subject.

There were two distinct bogies before the meeting. One representing the fire insurance companies, which was raised and promply laid; the other representing the municipalities did not wait to be raised, but appeared before the Institution with all its paraphernalia of chattering teeth and chains that bind in grandmotherly legislation.

The meeting was, however, prepared. Like the famous Sir Boyle Roche, who said, "Gentlemen, I smell a rat; I see him brewing in the air; but I will yet nip him in the bud!" speaker after speaker got up and hinted at some fell conspiracy which was being hatched by the people's representatives, and which would soon make this little island a purgatory to live in. It was left for Mr. Raworth, however, to define this conspiracy, and nail it to the counter; and when he drove the shaft home by pointing out the iniquity of the city of Glasgow, where a policeman may fetch you out of bed at any time of the night, and ask to see your marriage certificate, the sluice gates were opened, and the flood of individualism swept everything before it. "Down with all rules, and keep the pressure constant," was the universal battle cry; gas companies were added to the list of enemies, and taken in the flank, and the impetuous tide swept on until it was suddenly brought to a standstill by a simple remark in a small voice, to the effect that if all rules were abolished, the market would be swamped with cheap German goods. This interruption brought the meeting to its senses, and when the chairman put Mr. Crompton's resolution to the effect that the Council of the Institution should take steps to press the insurance companies and public supply authorities to adopt the Institute's rules, the battle-cry was forgotten and everyone voted straight.

As far as the supply of electrical energy and the wiring industry are concerned, this debate will no doubt have momentous results, for it is the first time that the Institution has been thoroughly aroused or has had occasion to interfere with the trade. Now, however, that the Council finds that it is backed up by the Institution generally, it is to be hoped that it will act energetically so as to bring all the parties concerned into line by the adoption of its own rules, or, better still, of rules based on these.

There is no doubt that many speakers overshot the mark in making analogies and raising bogies. We hold no brief for that unhealthy illuminant called gas, nor is it apparent at first sight why the insurance companies should pass such things as swivel brackets between lace curtains, or waterslide chandeliers, when they draw up such minute rules to be observed in the wiring of houses for electric light. But it must not be forgotten that, in the first place, the premiums for electrically lighted buildings are lower than where gas is the illuminant; and, secondly, it may be asked whether the insurance companies have ever been known to insist on all the minutiæ of their rules being observed—whether, in fact, they do much more than ask for the insulation test. As a matter of fact, it may be questioned whether, supposing the world had never known Mr. Musgrave Heaphy, the insurance companies would have troubled any more about rules for electric lighting than they have for gas lighting.

Unfortunately, man still retains traces of his simian ancestry, and these break out occasionally—perhaps in no more frequent manner than in that kind of apeing called fashion. And so, one insurance company having made rules, all the others did likewise, to be duly observed and obeyed, and to terrify the consumer.

It can then further be asked why the electric supply authorities have also issued rules which not only clash with the insurance companies' rules, but still further terrify the consumer, who finally decides to have the incandescent gas light, as there is so much danger in the electric light. It is presumably to be supposed that the electric supply authorities really do not wish to control anything further than the balance of their system and the insulation in each house; but there are so many factors which go to destroy this insulation that it is inconceivable how, quite apart from the example set by the insurance companies, they could be prevented from making rules for the wiring also. To put the matter in a nutshell, rules had to be made to keep the workmanship up to a high standard, not, be it noted, because leakage really seriously affects the supply, but in order to keep up the reputation of the electric light in the eyes of the consumer and in the interest of the supply authorities, and whilst there are such persons as jerry wiremen and dishonest contractors, it may be said of the rules:—

> There they are, and there they'll be,
> Until to the matter the public see.

It is all very well to talk of standardising electric wiring systems, so that a house can be wired as simply and as cheaply as if it were "gas-piped," as this is all nonsense. It is easy enough to put iron pipes in the walls and under the floors, and stop up the joints with white lead, so that even if there is a leak, this can be immediately detected by means of the nose. What does the consumer think about this? As soon as a man smells gas, he either strikes a match, and is promptly blown into eternity, when his widow gets the insurance money, and the papers put in a small corner "fatal gas explosion," or else he sends for the gasfitter, has the leak mended, and thinks no more of it. But in the case of the electric light matters are very different; wires have to be encased in metallic or vegetable casing, and when they are once drawn in there is no smell to indicate that anything is wrong. Mysterious little boards and other things are put about the house in glass cases, and then if anything is amiss, the consumer is either placed in darkness or perhaps receives a shock. He may elect occasionally to put up with the bad smell of gas, but an illuminant which suddenly without warning violently contracts his muscles, or puts him to the inconvenience of buying candles, or, if he be more advanced, to the trouble of getting up from his dinner table and putting in a new lamp or a new fuse—all these things militate against the popularity of the electric light and must be avoided. They can all be avoided by the employment of good workmanship and material, but these can only be guaranteed by the issuing of certain rules, and—what is much more important—their enforcement.

The latter point seemed in the enthusiasm of the moment to be quite overlooked at the debate in question. The Institution may succeed in inducing all the authorities to agree to the Institution rules, or an amended form of them, to be arrived at by mutual give-and-take. But how are such things to be avoided as were shown by Prof. Ayrton to exist in the case of flexible wires, unless the supply authority has the power to pounce down suddenly on an installation and test samples of the wires or fittings which are being put in? Is this grandmotherly legislation? If so, it is necessary. Are these Manchester methods? If so, let us have them, as long as they are universal and similar. Why, the very gentlemen who inveighed so strongly against municipal control and testing of fittings — who themselves are interested in many supply companies, each of which issues rules to consumers; who get their knife into every concern which does not hold their views as to systems of supply—these very people would benefit if the standard of work were forcibly kept up. There would be fewer failures of light, fewer repairs, increased confidence on the part of the consumer, and consequently increased business all round.

But these things can only come to pass if the Council of the Institution of Electrical Engineers will consider means of enforcing their rules at the same time as they devise means for making the rules general.

If they will, or cannot themselves undertake the testing of fittings and wires, let them, in consultation with the supply authorities, draw up at the same time a series of rules for testing fittings without interfering with the development of new ideas or designs.

If every supply authority, then, would make it a condition for connection to the mains that it should be consulted on the point of the accessories to be used, and that it should have the right to test samples of wire, &c., taken at random off the job; and if (and this is most important) all supply authorities were to act in this direction according to some

common line of action, which could be annually renewed or amended in consultation, in the same way as (to take an analogy) the M.C.C. rules are continually kept up to date, there is no doubt that the jerry contractor would soon be a thing of the past, and the honest contractor would flourish in the land and rejoice.

The only speaker who seemed to be aware of the importance, not only of the necessity of keeping work up to a high standard, but of the inadequate means at present to hand of attaining this, was Prof. Ayrton, and it is to be hoped that he will use his influence on the Council to devise a means of preventing such wires as he showed being put on the market.

THE SCHEMES OF THE BRITISH ELECTRIC TRACTION COMPANY.

The name of the British Electric Traction Company is well known to financiers, and possibly to some electrical engineers also.

The company is not, strictly speaking, a benevolent institution, though the results which it endeavours to achieve will undoubtedly be most beneficial in their effects.

To apply electric traction to existing horse tramways is part of its programme, but, taken alone, so small a part that it scarcely deserves consideration, for the *principal* aim of the company is to give effect to those new and extensive powers which the introduction of electric transmission of energy has placed at the disposal of the engineer.

At a very early date Mr. Garcke perceived that the increase of speed and diminution of working expenses attainable by the use of electric traction would at once open up new possibilities for tramways, for not only would they become useful to the man of business as well as to the cripple and the charwoman, but they would, if properly designed and carried out, constitute the natural means of communication between adjacent towns and their intermediate suburbs and villages.

The idea seems simple enough, but the practical development of it is entitled to claim comparison with the severe labours of Hercules. To an ordinary observer it seems incredible that a person or a company, coming forward with unlimited capital, and offering to transform and combine the tramways of a large industrial district, buying out opposing interests, altering the gauge where necessary, and generally putting life and health into an all but cremated corpse, would be received as a public benefactor.

But the ordinary observer does not understand how this world is governed; no sooner does the man or the company with money appear on the scene, than they forget the accumulated wisdom of the ages, and prefer to kill the goose that lays the golden eggs, rather than wait even a short time for the development of those permanent advantages which can only be obtained by forethought and patience. The methods are various, but the results are similar. This general indication is sufficient to show the nature of the difficulties which the British Electric Traction Company have had to face in carrying out their schemes, sometimes greater and sometimes less, but usually complicated by other difficulties arising out of existing contracts or personal eccentricities.

A good example of the work of the company is to be seen in the nest of North Staffordshire towns, known as the Potteries. For many years past the North Staffordshire steam tramway has run through this district, but it has served only a small section of the population, and that small section very imperfectly.

The British Electric Traction Company has bought this line, re-laid and equipped it with electric power, and is extending the system in every direction, so that all parts of this hive of industry will be in touch with every other part.

In South Staffordshire the same idea is being worked out, but under considerably greater difficulties. Here many municipalities have to be educated up to the electrical standard. Many interests have to be bought out, and in some cases the gauge of existing lines has to be altered. The result will be an inestimable boon to the district, unless one of the local authorities should succeed in their persistent attempts to spoil the scheme.

In other parts of England, as, for instance, the Tyneside, the Oldham and Ashton district, Barrow-in-Furness, Swansea, and the South Wales valleys, the company is doing similar work. In many other places it has acquired tramways, which it will ultimately develop and combine, or extend in similar manner. Altogether, the aggregate lengths of the lines to which the company is connected, would be sufficient to connect London with Carlisle, and although there is no intention to compete with the London and North-Western Railway, it cannot be doubted that this country can find openings in tramway work for an organisation of at least equal size, and probably even greater prosperity.

The prosperity will depend entirely on management; in good commercial hands it will be quite satisfactory, but it is by no means certain that electric trams are any more likely than other commercial projects to provide a Royal road to fortune.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

11,158A. "Improvements in electric couplings for railway cars." H. H. Leigh. (F. J. Sprague, U.S.) Dated February 16th. (Date claimed under Patents, Rule 19, May 16th, 1898.) (*Complete*)

11,158B. "Improvements in pilot apparatus and reversing mechanism for controlling electric motors." H. H. Leigh. (F. J. Sprague, U.S) Dated February 16th. (Date claimed under Patents Rule 19, May 16th, 1898.) (*Complete*)

3,137. "Improvements in the construction of electric conduits or cable carriers." J. J. Green. Dated February 13th.

3,141. "Temporary cord connections for telephone switchboards, &c." A. Broadbent. Dated February 13th.

3,151. "New or improved apparatus for imparting a preliminary heating to refractory filaments of electric lamps in order to render the same conductors of electricity." C. A. Lee. Dated February 13th.

3,152. "A means of operating hydraulic machinery by electricity." W. H. Willatt. Dated February 13th.

3,160. "Improvements in and relating to electro-magnetic cut-outs and other like apparatus specially applicable to electric arc lamps." H. Smithson and E. R. Sharpe. Dated February 13th.

3,177. "Improvements in or relating to electrically illuminated advertising mediums or the like." W. T. Bell. Dated February 13th.

3,182. "Charging stand and contact for storage batteries." G. H. Condict. Dated February 13th. (Date applied for under Patents, &c., Act, 1883, Section 103, July 18th, 1893, being date of application in U.S) (*Complete.*)

3,187. "Improvements in and connected with road vehicles driven by electric current from conductor." A. M. Taylor and C. H. Greenbank. Dated February 13th.

3,233. "Improvements in cables for carrying electric currents." L. Belknap and A. Sundh. Dated February 14th. (*Complete.*)

3,252. "Improvements in lining electric wood casings or conduits with steel or other metallic substances." C. J. Wightman and A. Hudson. Dated February 14th.

3,269. "A new or improved tilting device for the shades of electric incandescence lamps." M. Railing. Dated February 14th.

3,311. "Improvements in or relating to arc lamps." W. P. Thompson. (C. J. Toerring, U.S.) Dated February 14th. (*Complete.*)

3,316. "Improvements in or connected with electrically propelled and (or) controlled vessels." R. B. Painton and W. H. Bainbridge. Dated February 14th. (*Complete.*)

3,339. "Improvements in electric traction." E. G. Pink. Dated February 15th.

3,374. "Improvements method of and means for correctly and automatically guiding the trolleys of the connecting arms of cables of electric trams, electric railways, and the like." C. H. Mounsey and J. F. Walsh. Dated February 15th.

3,387. "Improvements in trolley apparatus for use in connection with electric traction." I. E. Winslow. Dated February 15th. (*Complete.*)

3,389. "Jointing conductors of the metal oxides to wires in incandescent electric lamps." H. Moul. Dated February 15th.

3,391. "An improved connector for electric light and power circuits for theatrical and other purposes." J. Archbutt. Dated February 15th.

3,392. "Improvements in automatic switches for starting and stopping electric motors." Powell-Jones & Co. Dated February 15th.

3,417. "A means of operating hydraulic or pneumatic machines and tools, and forcing water into boilers and other vessels by electricity." W. H. Willatt and A. E. Seaton. Dated February 16th.

3,434. "Improvements in tele-dynamic controlling apparatus for steering engines." J. L. Boothman and W. Hastie. Dated February 16th.

3,440. "Improvements in and connected with means for electrically lighting railway carriages." E. Dick. Dated February 16th. (*Complete.*)

3,469. "Improved primary battery." L. Encausse and L. Encausse. Dated February 16th.

3,477. "Safety contact interrupter for suspended electric wires or cables." R Ducornot. Dated February 16th.

3,518. "Improvements in automatic electrically signalling the adjustment of dummy clocks." R. P. Gerland. Dated February 17th.

3,531. "Improvements in or connected with electric batteries." E. A. Jahncke. Dated February 17th.

3,536. "Improvements in and relating to telegraph and like cables." J. A. L. Dearlove. Dated February 17th.

3,570. "Improvements in or connected with storage batteries." W. O. Rooper. Dated February 17th.

3,586. "An arrangement for connecting accumulator cells and the like." F. Faber. Dated February 17th. (*Complete.*)

3,591. "Improvements in telephone switch apparatus." L. M. Ericsson. Dated February 17th. (*Complete.*)

3,594. "Improvements in arc lamps." H. Baggett. Dated February 17th.

3,597. "Improvements in or relating to electric railway switching and signalling apparatus." A. J. Boult. (The Continental Hall Signal Co., Belgium.) Dated February 17th. (*Complete.*)

3,648. "Improvements in or relating to the electrolysis of salts in solution and apparatus therefor." A. J. O. Chalandre, L. J. B. Colas, and C. J. Gerard. Dated February 18th.

3,665. "Improvements in electric incandescence lamps." O. Imray. (W. Hernst, Germany.) Dated February 18th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. *(in stamps).*

1897.

251. "Improvements in secondary batteries and process of forming same." G. W. Harris and R J. Holland. Dated January 5th, 1897. The plates are made from a single integral piece of lead by moulding, rolling, or sawing into the form of an open work or skeleton plate, having oppositely inclined intersecting ribs and grooves on its opposite side, and the grooves are open at the sides and bottom of the plate to allow of expansion, and to prevent the plate from buckling At the top of the plate is a flange with a grove in which the connecting bar is fixed. The plates are formed in a bath composed of two acids, one of which, *e.g.*, sulphuric acid is a non-solvent or slight solvent of lead, while the other, *e.g.*, acetic acid, is a solvent, together with one or more salts of each acid. The plate is subsequently formed in a bath composed of dilute sulphuric acid and an acid sulphate, and in this bath the positive electrodes are reduced to form negative electrodes as required. 6 claims.

1,239. "Improvements in the means and apparatus for effecting electrical traction on railways and tramways by a contact rail and trolleys at the ground level." R Demeuse. Dated January 16th, 1897. Relates to a sectional conductor system with electro-magnetic switches. *Conductors, Switches, Collectors:*—The sectional conductor is connected to the pivot of the armature. A current derived from the collector to excite the magnet flows to earth through the armature and contacts, which are broken when the armature moves to complete the main circuit. The whole current then flows through an electro-magnet and maintains the armature in position until the vehicle passes off the section, when it falls, being assisted in some cases by an electro-magnet connected to the section in advance. The collector has two contacts bearing at the same time on the conductors, and the rear one has a resistance in series with it. 3 claims.

1,789 "Improvements in electric cables." W. S Smith and W. P. Granville. Dated January 22nd, 1897. Conductors of the kind described in specification No. 8,573, are provided with leaks between the conductors of any pair where more than one pair exists in a cable. The leaks consist of lengths of, or spirals of, ribbon or wire with or without an iron core. In some forms the leaks consist of perforations through the insulation, the inner coating of which is coated with plumbago. Stops or plugs of insulating material may close the central cavity between the leaks. The central cavity may be filled with material having low specific inductive capacity or having the power of decreasing the resistance of gutta-percha. The inner surface of the insulation may be varnished, &c. 6 claims.

2,578. "Improvements in the arrangement of field coils of shunt motors for use with storage or other batteries, and method of connecting such coils with the batteries." T. H. Parker. Dated February 1st, 1897. For the purpose of varying the electromotive force at the armature terminals of a shunt motor used in connection with storage or other batteries, while maintaining a constant E.M.F. at the field terminals, the field coils are arranged in sections which are separately connected with corresponding sets of battery cells, and, by means of a multiple switch, the batteries are changed from series to series-parallel or parallel, as required. 1 claim.

3,019. "Certain improvements in joint pieces for electrical conductors." E. Ivins. Dated February 4th, 1897. Three tubes are formed by indenting the sides of a jointless tube, or by soldering three tubes together or otherwise. The wires to be connected are passed through two of the tubes, and the ends bent back around the wires and inserted into the third tube. By tightening the wires a good contact is obtained. 5 claims.

3,120. "Improvements in incandescent electrical lamps and their connections or holders." W. P. Thompson. (F. R. Pope, Holland.) Dated February 5th, 1897. *Incandescent Lamps*—The necks of bulbs are formed with irregularities of any kind to engage with corresponding irregularities in caps in such a way that the weight of the lamp cannot detach it from the cap. The bulb is preferably further secured by solder, but without plaster, so that a spoilt lamp may be separated from its cap, repaired, and replaced. Specification No. 2 343 (1895) is referred to. In the bulb illustrated, one or more bayonet grooves are moulded in the glass of the neck to engage studs fixed in the cap; when so engaged, solder or other suitable substance is introduced through a hole in the cap into one of the grooves. In other constructions the grooves are slanted, or the bulb neck is screwed, or carries the studs, or is made with depressions which receive the ends of tongues stamped in from the cap, or receive buttons projecting through holes in the cap from a spring or band. This may extend half round the cap and be soldered or sprung on, or metal or wire fused into the glass of the bulb may engage holes in the cap. The provisional specification mentions the use of solder alone, placed in holes in the cap and depressions in the glass. 3 claims.

3,722. "Improvements in grooved frames, carriers, or supports for holding or suspending accumulator plates, photographic plates, and other plate-like articles." W. P. Thompson. (Firm of C. W. Kayser & Co., Germany.) Dated February 11th, 1897. Consists of grooved frames, carriers, or supports for accumulator plates. One form, consisting of a number of alternating wide or narrow strips threaded on rods and held together by end plates. Many modifications are described. The strips may be held together by tongues on one projecting into grooves in adjacent strips: these strips, instead of being of equal height, may be alternately long and short so that projections on the plates may rest on the top of the shorter strips; a number of strips may be made out of one piece of material; the short or narrow strip may be reduced to projections from the others; and the strips may be corrugated or perforated. In some cases only a few of the strips need reach to the bottom of the cells. 4 claims.

4,138. "Improvements in and connected with electric furnaces." F. G. Patten. Dated February 16th, 1897. Relates to electric furnaces. The upper electrodes are plates arranged transversely over a sloping block, which is the lower electrode, so that materials fed at the upper end pass below the upper electrodes successively. A magnetic field is produced in the direction of the slope by magnets placed near the furnace, and either the current forming the arcs or that exciting the magnets is slowly alternated to cause the arcs to travel across the slope in the arrangement illustrated; a dynamo supplies continuous current to the furnace and to a liquid reverser, which is rotated by a motor, and supplies alternating currents to the magnets. 9 claims.

4,755. "Improvements in electric motor propelled vehicles." H. G. Morris and P. G. Salom Dated February 22nd, 1897. Relates to motor road vehicles. The vehicle is propelled by an electric motor and batteries supported by a pair of wheels towards the front of the vehicle, so that any kind of carriage or waggon body may be applied without disturbing the design of the motor portion. The motors are carried on the front fitted axle, and are connected through suitable gearing so as to drive separately the wheels. The storage batteries are contained in the casing which surmounted by the driver's seat and rests on a transverse spring. The latter is carried at the ends by springs, on which the vehicle body is also partly supported. The vehicle is steered through the medium of the rear wheels, which are mounted on swivelling axles and are capable of being adjusted by the handle. The motor controller is operated by a handle, and on each motor shaft is a brake operated by a pedal. 9 claims.

5,714. "Improved system of fitting up electric bells." H. W. Johnston. Dated March 4th, 1897. Relates to a bell circuit consisting of two main wires, with branch connections to various contact makers, an indicator and battery being inserted in the circuit, so that, on making contact at one of the "call stations," the indicator shows the position and completes a secondary bell circuit, the bell ringing continuously till the indicator is reset. Each contact maker is of such form as to make a known number of contact and breaks at each operation, the number being shown on the indicator dial and corresponding to a known position. In a form shown, the cover can be rotated by a knob, pins on the underside causing a spring to make and break the circuit a definite number of times through the spring contact. The armature of the indicator magnet, normally raised by a spring, controls an escape wheel mounted on a spindle and operated by a weight or spring. On each completion of the main circuit the wheel rotates one tooth, and a pointer on the spindle shows the total number on the indicator dial. A disc on the spindle has a block of vulcanite, against which a spring contact rests when the pointer is at zero. When a call is received, the disc is rotated and the secondary or bell circuit is completed through the spring and a metal strip on the disc, the bell continuing to ring till the pointer is set to zero. 1 claim.